# BIOLOGICAL ASSESSMENT

# FOR

# CASPIAN TERN MANAGEMENT TO REDUCE PREDATION OF JUVENILE SALMONIDS IN THE COLUMBIA RIVER ESTUARY

## NOAA Fisheries Jurisdiction Species

# INTRODUCTION

### Purpose and Need of Proposed Action

In 1999, National Marine Fisheries Service (NOAA Fisheries) called for the U.S. Army Corps of Engineers (Corps) to eliminate Caspian tern (*Sterna caspia*) nesting from Rice Island (located in the upper Columbia River estuary) in an attempt to decrease the number of juvenile salmonids consumed by terns. In 1999, the Corps initiated a pilot project to relocate the Rice Island tern colony to East Sand Island, near the mouth of the estuary, where marine fish (i.e.,, non-salmon) were abundantly available to foraging terns.

In 2000, the Corps proposed to complete a project to prevent Caspian tern nesting on Rice Island, in the Columbia River Estuary, while attracting terns to nest on East Sand Island, near the mouth of the river. As a result of the proposed actions in 2000, Seattle Audubon, National Audubon, American Bird Conservancy, and Defenders of Wildlife filed a lawsuit against the Corps alleging that compliance with the National Environmental Policy Act for the proposed action of attracting the large colony of Caspian terns from Rice Island to East Sand Island was insufficient, and against the Service in objection to the potential take of eggs as a means to prevent nesting on Rice Island. In 2002, all parties reached a settlement agreement. The settlement agreement stipulates that the Service, Corps, and NOAA Fisheries prepare an Environmental Impact Statement (EIS) to address Caspian tern management in the Columbia River estuary. The purpose of the proposed action is to comply with the 2002 Settlement Agreement by identifying a management plan for Caspian terns in the Columbia River estuary that reduces resource management conflicts with ESA-listed salmonids while ensuring the conservation of Caspian terns in the Pacific Coast/Western region.

Alternative C, the Preferred Alternative of the draft EIS (DEIS) (Service *et al.* 2004b), would reduce tern predation on juvenile salmonids in the Columbia River estuary by managing habitat to redistribute the tern colony on East Sand Island throughout the Pacific Coast/Western region.

This redistribution would be achieved by creating new or enhanced tern nesting habitat throughout the region and reducing the tern nesting site on East Sand Island to 1 to 1.5 acres. To ensure a suitable network of sites is available for terns on a regional scale, the Action Agencies propose to manage nesting habitat for terns in the region to replace twice the amount of occupied nesting habitat that would be lost on East Sand Island.

The proposed habitat creation or enhancement projects are proposed in eight locations in Washington, Oregon, and California: Dungeness National Wildlife Refuge (NWR) in Washington; Fern Ridge Lake, Summer Lake Wildlife Management Area, and Crump Lake in southern Oregon; and Brooks Island, Hayward Regional Shoreline, and Don Edwards NWR, in San Francisco Bay, California. For additional information on the background of the proposed project, the DEIS can be viewed at the following internet site: http://migratorybirds.pacific.fws.gov/CATE.htm.

**Listed Species and Critical Habitat**
This Biological Assessment (BA) addresses species listed under the authority of the Endangered Species Act (ESA) that are under NOAA Fisheries' jurisdiction. This BA will evaluate the effects to listed species at six locations in three western states – Washington (1); Oregon (2); and California (3). The Summer Lake Wildlife Management Area and Crump Lake locations do not support populations of listed salmonid ESU's under NOAA Fisheries jurisdiction and thus, are not addressed in this BA. The nearest streams with anadromous fish runs (John Day, Rogue and/or Klamath Rivers) are greater than 100 miles distant from Summer or Crump lakes.

**Formal Consultation Request**
We are requesting formal consultation, due to unavoidable adverse effects, for the following evolutionary significant units (ESUs): Puget Sound Chinook salmon (*Oncorhyncus tshawytscha*), Hood Canal summer-run chum salmon (*Oncorhyncus keta*), Upper Willamette River Chinook salmon, Central California Coast steelhead (*Oncorhyncus mykiss)*, Central Valley steelhead, Central Valley spring-run Chinook, Sacramento River winter-run Chinook, and Central California coast coho (*Oncorhyncus kisutch*).

**EFH Consultation**
Additionally, we are requesting consultation under section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act for managed species with designated essential fish habitat that may be adversely affected by the proposed action. Please refer to Table 1 in the attached essential fish habitat assessment for a list of these species.

**Organization of the Biological Assessment**
An overview of Caspian tern (*Sterna caspia*) biology is presented first, followed by project descriptions and affected species, organized by site. Listed species will be addressed by location due to the substantial geographical distribution and generally different suite of species associated with each location. Should there be substantial changes in project design during the Plans and Specifications stage of implementation planning efforts that will affect listed species differently than that assessed below for conceptual site designs, consultation will be reinitiated with the Service prior to construction.

# CASPIAN TERN BIOLOGY

## Species Range

Caspian terns breed at widely scattered sites across North America. Wires and Cuthbert (2000) described five disjunct breeding regions in North America. Caspian terns breeding in the Columbia River estuary are in the Pacific Coast/Western Pacific Coast region. This region includes coastal Alaska, southwestern British Columbia, Washington, Oregon, California, Baja California, and Sinaloa, Mexico; and interior Washington, Oregon, California, southern Idaho, Montana, Wyoming, western Nevada, and northern Utah.

## Pacific Coast Region Overview

Since the beginning of the 20th Century, the Pacific Coast regional population has shifted from nesting in numerous small colonies associated with freshwater marshes in interior California and southern Oregon, to primarily larger colonies along the coast extending into the State of Washington (Gill and Mewaldt 1983). Caspian terns adapt to spatial and temporal variability of breeding habitat and prey, leading to highly variable colony locations and sizes within the region.

In recent years, terns were documented to have nested on about 60 sites scattered throughout the Pacific Coast region, including Alaska. This habitat base serves as a network of sites, which individually may vary in suitability from one year to the next but collectively provide a suite of locations for terns on a regional scale. Colonies in the interior are characteristically small in size and are subject to substantial shifts in location, quantity, and quality corresponding to cycles of flood and drought. Interior sites may also be subject to intensive management such as the control of reservoir and irrigation water. Larger colonies (e.g., many hundreds to thousands of terns) have been documented primarily along the Pacific Coast.

Coastal nesting habitat can be managed or natural, and is typically subject to erosion and vegetation changes over time. Although ocean conditions may affect prey availability, coastal prey resources are typically more diverse, abundant, and stable in comparison to prey resources at interior sites which are highly variable from year to year. For a detailed review of current, historic, and potential tern nesting habitat throughout the Pacific Region see: *A Review of Caspian Tern Nesting Habitat: A Feasibility Assessment of Management Opportunities in the U.S. Fish and Wildlife Service Pacific Region* (Seto *et al.* 2003).

## Habitat Requirements

Caspian terns nest in single-species colonies or in multi-species assemblages with other ground nesting waterbirds (gulls, skimmers, other terns, and cormorants). Caspian terns breed in a variety of habitats ranging from coastal estuarine, salt marsh, and islands. Terns typically nest in open, barren to sparsely vegetated areas, but also among or adjacent to driftwood, partly buried logs, rocks, or tall annual weeds. Nest substrates vary from sand, gravel, spongy marshy soil, or dead or decaying vegetation to hard soil, shell banks, limestone, or bedrock. Nests range from simple depressions in a bare substrate to nests lined with debris, such as shells, crayfish chelipeds, dried grasses and weed stems, wood, or pebbles.

## Diet and Foraging Range

Breeding terns eat almost exclusively fish, catching a diverse array of species with shallow plunge dives, usually completely submerging themselves underwater (Cuthbert and Wires 1999). The average foraging distance from the colony of terns during the breeding season on East Sand Island was observed to range from 13 to 21 km (Anderson et al. *In Review*).

The sizes of fish caught and diet composition are largely determined by geography and annual and seasonal prey availability, but most fish are between 5 to 25 cm and occur near the surface of the water. In the Columbia River estuary, diet studies of the tern colonies on Rice and East Sand islands documented that terns nesting on Rice Island (1999 to 2000) had an average of 83 (77 to 90) percent juvenile salmonids in their diet (Roby et al. 2002), while on East Sand Island (1999 to 2004), terns had an average of 33 (17 to 47) percent juvenile salmonids in their diet (Collis et al. 2002a, 2002b, 2003a, 2003b, K. Collis pers. comm.). From 1999 to 2003, the tern diet on East Sand Island, closer to the mouth of the Columbia River than Rice Island, was primarily non-salmonids, including northern anchovy, herring, shiner perch, sand lance, sculpins, smelt, and flatfish (Roby et al. 2002, Collis et al. 2002b and 2003a). As ocean conditions improved, and thus, ocean productivity, the percentage of juvenile salmonids in the diet of terns in the estuary has continued to decline in recent years.

Salmonid composition at other study sites were found to be variable. For example, in Grays Harbor, Washington, chum and coho salmon were found in the tern diet in low numbers (14 to 21 percent) and primary prey taken were shiner perch and northern anchovy (Penland 1976). At Dungeness NWR, salmonid composition of the tern diet was observed to be the second most important prey species (31 percent of tern diet) in 2004 (Roby et al. 2004). Both of these sites in Washington differ from that observed in Commencement Bay, a location south of Dungeness NWR in Puget Sound, Washington. In 2000, terns in Commencement Bay were observed to have an average of 52 percent salmonids in their diet (Thompson et al. 2002). It is possible that these observed differences in diet composition is because Grays Harbor and Dungeness NWR both contain a greater diversity and/or abundance of marine prey species than found in Commencement Bay due to the adjacent marine waters in these two locations.

In San Francisco Bay, diet studies conducted in 2003 and 2004 found that the tern diet varied among the various nesting locations in the bay, but primary prey species included anchovy, surf perch, silversides, herring, sunfish, gobies, and toadfish (Roby et al. 2003a and 2004). In 2003, salmonids (not including trout from reservoirs) were found in the diets of four out of five nesting colonies, ranging from 0.1 (Agua Vista Park and Baumberg Pond) to 8.7 (Knight Island) percent of prey items (Roby et al. 2003a). In 2004, juvenile salmonids were more prevalent in the tern diets, ranging from 1.4 (Agua Vista Park) to 26.1 (Knight Island) percent, and consisted primarily of non-ESA-listed species (Roby et al. 2004). The higher prevalence of salmonids in the tern diet was apparently due to a lower availability of marine fish during that year (e.g., northern anchovy and surfperch, Roby et al. 2004).

In interior Oregon (Summer and Crump lakes), a study conducted in 2003 found tui chubs to be the primary prey of nesting terns (Roby et al. 2003a). In San Diego, food habits of terns were studied in 1995, 1997, and 1998. These studies consistently found terns to feed primarily on sardines, anchovies, and topsmelt (Horn et al. 1996, Horn and Dahdul 1998 and 1999).

## Post-breeding and Migration

Average foraging distance for Caspian terns increases to 29 km during the post-fledging period (Anderson et al. *In Review*) and terns usually depart nesting areas within a month after fledging. Caspian terns migrate singly or in groups that can be as large as thousands (Shuford and Craig 2002). Most terns congregate for migration at traditional foraging locations along marine coasts and major rivers or freshwater lakes about a month after young have fledged (Shuford and Craig 2002). Timing of migration varies with region; fall movement typically occurs between mid-July and mid-September along the Pacific Coast (Shuford and Craig 2002).

# DESCRIPTION OF THE PROPOSED ACTION

The proposed action occurs at the following sites: Dungeness National Wildlife Refuge (NWR), Washington; Fern Ridge Lake, Oregon; San Francisco Bay, California.

## Dungeness National Wildlife Refuge, Washington

**Project Description**

Caspian terns nested on the Dungeness NWR in 2003 and 2004 on Dungeness Spit in an area currently designated closed to public use. The proposed action is to improve protection of this tern colony in order to provide suitable habitat conditions for additional Caspian tern pairs that may arrive at this location as a result of management efforts in the Columbia River estuary. The principal means to afford greater protection for the Dungeness NWR Caspian tern colony would be management of potential human disturbance (e.g., placement of additional signs to mark existing closed areas, increased outreach) and predators (e.g., fence around the colony). No habitat modifications are proposed at this site.

Research activities to monitor the Caspian tern colony occurred in 2004. It is anticipated that research activities will continue to occur at the colony location after implementation of the preferred alternative of the EIS. Research activities include construction of a blind near the colony site, prior to the arrival of nesting terns (early April), and personnel accessing the site daily via all terrain vehicles and by foot on the existing public use trail from early April through September. Research activity is accomplished from observations while sitting in the observation blind. Certain research activities require personnel to be outside the blinds for extended periods of time.

**Biological Assessment**

Two federally listed anadromous fish species under the jurisdiction of NOAA Fisheries may occur in the vicinity of the proposed project at Dungeness NWR. These include the threatened Puget Sound Chinook salmon and Hood Canal summer-run chum salmon.

### *Status of Species*

The Puget Sound Chinook salmon ESU, listed as threatened under the ESA (64 FR 14307), includes all naturally spawned Chinook populations residing below impassable natural barriers (e.g., long-standing, natural waterfalls) in the Puget Sound region from the North Fork Nooksack River to the Elwha River on the Olympic Peninsula, inclusive. According to the Puget Sound Chinook Salmon BRT's most recent status review, the natural spawning escapement estimates for Puget Sound Chinook salmon populations are improved relative to those at the time of the previous status review of Puget Sound Chinook salmon conducted with data through 1997 (NOAA Fisheries 2004a). The median across populations of the most recent 5-year geometric mean natural escapement for the same 22 populations through 1997 was N = 438 (compared to N = 771 through 2002), and the range across the 22 populations was 1 to 5,400 (NOAA Fisheries 2004a). Throughout the ESU, the estimates of trends in natural spawning escapements for Puget Sound Chinook salmon populations are similar to the previous status conducted with data through 1997 (NOAA Fisheries 2004a). Some populations exhibit improvements in trends, and others show more significant declines; the median across populations of the long-term trend in natural spawners was a 1.1 percent decline per year through 1997, compared to a median estimate indicating a flat trend through 2002 (NOAA Fisheries 2004a). Short-term trends are generally more positive in recent years—the median trend across 22 populations through 1997 was a 4 percent decline per year, and the median trend through 2002 was a 1.1 percent increase per year (NOAA Fisheries 2004a).

The Hood Canal summer-run chum salmon ESU, listed as threatened under the ESA (64 FR 14507), includes all naturally spawned chum salmon residing below impassable natural barriers (e.g., long-standing natural waterfalls) in the Hood Canal and eastern Strait of Juan de Fuca regions of Washington State, extending to the Dungeness River. Estimated natural-origin returns and the total number of natural spawners (i.e.,, the combination of natural-origin and hatchery-origin summer chum salmon included in the ESU) have increased dramatically for most of the populations since 1999, when the ESU was listed as threatened (NOAA Fisheries 2004a). Average total (aggregate natural- and hatchery-origin summer chum salmon) escapements to natural spawning areas for the most recent five years are generally above interim recovery goals derived for each population that has been the subject of supplementation actions (NOAA Fisheries 2004a). Adult returns to Big Beef Creek and Chimacum Creek as a result of two population reintroduction programs have led to substantial adult returns to natural spawning areas where no fish had been present for two decades (NOAA Fisheries 2004a).

**ARRIVAL TIMES OF JUVENILE SALMONIDS IN DUNGENESS BAY AND NESTING PERIOD OF CASPIAN TERNS AT DUNGENESS NWR.**


### *Presence, abundance, and habitat use in Project Area*

Dungeness Bay is an important nursery habitat for a variety of fish species. Dungeness Spit is located within the Dungeness National Wildlife Refuge. Its location at the southeastern end of the Strait of Juan de Fuca indicates that a substantial portion of the approximately two million Chinook salmon juveniles that emigrate annually from Puget Sound migrate along the nearshore of Dungeness Spit. No estimate of juvenile chum salmon was determined for Puget Sound.

***Environmental Baseline***

The biological requirements for Puget Sound Chinook and Hood Canal summer chum salmon in the action area can best be expressed in terms of the essential features of their habitat. That is, the salmon require adequate: (1) substrate (especially spawning gravel), (2) water quality, (3) water quantity, (4) water temperature, (5) water velocity, (6) cover/shelter, (7) food, (8) riparian vegetation, (9) space, and (10) migration conditions (65 FR 7764). The best scientific information presently available demonstrates that a multitude of factors, past and present, have contributed to the decline of west coast salmonids by adversely affecting these essential habitat features (NOAA Fisheries 2003a).

***Habitat:*** A variety of habitat issues have been identified for streams in the range of these ESUs because of urbanization, forest and agricultural practices including (1) changes in flow regime (all basins), (2) sedimentation (all basins), (3) high temperatures (Dungeness, Elwha, Green/Duwamish, Skagit, Snohomish, and Stillaguamish rivers), (4) streambed instability (most basins), (5) estuarine loss (most basins), (6) loss of large woody debris (Elwha, Snohomish, White, and Skokomish rivers), (7) loss of pool habitat (Nooksack, Snohomish, and Stillaguamish rivers), and (8) blockage or passage problems associated with dams or other structures (Cedar, Elwha, Green/Duwamish, Snohomish, and White rivers) (NOAA Fisheries 2003a). Further, agriculture practices have played a role in degrading riverine and estuarine habitats. These activities and the resulting habitat modifications have greatly degraded extensive areas of salmon spawning and rearing habitat in the Puget Sound, and the rising population density in parts of Washington will also continue to adversely affect the quality and quantity of local water resources for Chinook and Hood Canal summer chum salmon (NOAA Fisheries 2003a).

To counteract all the negative effects listed above, Federal, state, tribal, and private entities, singly and in partnership, have begun recovery efforts to help slow and eventually reverse the decline of salmon and steelhead populations. Notable efforts within the range of PS Chinook and Hood Canal summer chum salmon ESUs are the Shared Strategy recovery planning process, the *Summer Chum Salmon Conservation Initiative*, habitat restoration and protection actions implemented at the local level by local jurisdictions through the Pacific Coast Salmon Recovery Fund, Shorelines Management Act, Habitat Conservation Plans, and the Northwest Forest Plan. Despite these efforts, much remains to be done to recover these listed species and other salmonids in the Puget Sound basin (FR 69 33102, June 14, 2004).

***Hatcheries:*** Fall-, summer-, and spring-run Chinook salmon stocks are artificially propagated through 41 individual WDFW and tribe-managed programs in Puget Sound. Currently, the majority (95 percent) of the 48 million juvenile fish released annually in the region are fall-run Chinook (also called summer/fall) stocks produced for the purpose of enhancing fisheries. Approximately half of the spring- and summer-run stocks in the region are currently sustained by hatchery supplementation programs (NOAA Fisheries 2003a). Supplementation programs currently exist for early-returning Chinook salmon populations in the North Fork Nooksack River, the North Fork Stillaguamish River, the White River, the Dungeness River, and the Elwha

River (NOAA Fisheries 2003a). Chinook salmon hatchery programs in Puget Sound are currently under evaluation by NOAA Fisheries for compliance with ESA protective provisions defined in 1999 for listed natural Chinook populations.

NOAA Fisheries concluded in a 2002 biological opinion that eight summer chum salmon supplementation and reintroduction programs implemented under the *Summer Chum Conservation Initiative* (WDFW and PNPTT 2000) in the Hood Canal and Strait of Juan de Fuca regions were not likely to jeopardize the continued existence of the listed Hood Canal summer chum salmon ESU. Furthermore, NOAA Fisheries concluded that the supplementation and reintroduction programs were effective in increasing production of summer chum fry above levels feasible through natural production and also provide a survival benefit to Hood Canal summer chum salmon. Specifically, NOAA Fisheries concluded that the status of Hood Canal summer chum populations had declined to such low levels that the risk of extinction to portions of the ESU in the short term was high. In combination with other management actions aimed at addressing factors for decline, supplementation and reintroduction could be effectively applied to reduce the short-term risk of extinction to existing natural-origin populations and help restore natural summer chum production to healthy levels within the ESU. The artificial production programs provide a short-term boost in productivity, conserve distinct population structure within the regions, assist in the reintroduction of summer chum into vacant habitat that appears unlikely to be re-colonized within a reasonable timeframe, and help prevent the extinction of the ESU. The programs are benefiting the abundance, spatial structure, and diversity of the listed summer chum ESU.

The production of hatchery fish can potentially harm naturally produced salmon and steelhead in four primary ways: (1) ecological effects, (2) genetic effects, (3) overharvest effects, and (4) masking effects (NOAA Fisheries 2003a). Ecologically, hatchery fish can prey upon, displace, and compete with wild fish. These effects are most likely to occur when fish are released in poor condition and do not migrate to marine waters, but rather remain in the streams for extended rearing periods. Hatchery fish also may transmit hatchery-borne diseases, and hatcheries themselves may release disease-carrying effluent into streams. Hatchery fish can affect the genetic composition of native fish by interbreeding with them. Interbreeding can also be caused by humans taking native fish from one area and using them in a hatchery program in another area. Interbred fish are less adapted to the local habitats where the original native stock evolved and may therefore be less productive there. To address these potential hatchery-related hazards, the state and tribal harvest managers (comanagers) have collaborated with NOAA Fisheries to implement changes in the ways hatcheries are operated. Hatchery reform measures implemented over the last 20 years have included development of a Fish Health Policy to minimize the risk of fish pathogen transmittal, changes in hatchery rearing and release practices to minimize interactions with natural fish, hatchery fish production reductions to reduce competition and predation risks, and changes in hatchery broodstock sources to local-origin stocks..

***Harvest:*** The Puget Sound Chinook Salmon ESU includes 22 Chinook populations distributed over five distinct geographic areas and several life history types. At the time of listing, high harvest rates and aggregate stock harvest management practices were cited as two potential factors of decline. The latter was primarily due to the inability to distinguish between hatchery and wild Chinook. The state comanagers have adapted and improved harvest management strategies in response to improved information on stock status since the early 1990s. As a result, total exploitation rates have decreased 14 to 63 percent from rates in the 1980s.

Since 1999, the comanagers and NMFS have worked together on the development of a harvest management framework that would also address ESA goals. Under the harvest management framework, salmon fisheries are managed to meet the requirements of the natural populations, rather than primarily to harvest returning hatchery fish, which was the case historically in several of the Puget Sound regions. Harvest objectives have been revised to be consistent with what is known of the productivity of the various watersheds and the contribution of hatchery spawners. The harvest plan also includes implementation, monitoring, and evaluation procedures designed to ensure fisheries are consistent with fishery objectives for conservation and resource use. These procedures include monitoring hatchery contribution to natural spawning populations, better accounting of incidental catch mortality, evaluation of the selective effects on size or age that fisheries may have, and better assessment of the productivity of the various watersheds. The comanagers have also implemented area, time, and gear restrictions to maximize harvest opportunity on hatchery and healthy listed Chinook populations and minimize impacts to weaker Chinook populations. Among others, these actions include complete closure of some terminal fisheries, non-retention of Chinook, and selective fishing techniques (PSIT/WDFW 2004). Since the ESU was listed in 1999, Puget Sound Chinook salmon escapements have been stable or increasing for all populations in all regions and life history types, an apparent positive response to the decline in exploitation rates, in combination with other factors. Recent years' average escapement for all but one population (North Fork Nooksack) is above the critical escapement thresholds, and two or more of the populations in three of the five regions (10 populations over all regions) (Whidbey/Main Basin: Upper Skagit, Lower Skagit, Upper Sauk, Lower Sauk, North Fork Stillaguamish; Southern Basin: Duwamish-Green, Puyallup, White, Nisqually; Hood Canal: Skokomish) have exceeded their viable escapement thresholds, representing the range of life history types in each region.

Under the harvest regime anticipated over the next several years, all but one of the populations (North Fork Nooksack) in the ESU is expected to exceed its critical escapement threshold, in most cases by substantial margins. Sixty percent or more of the populations in two of the five ESU regions are expected to meet or exceed their rebuilding criteria for harvest (Whidbey/Main Basin: Upper Skagit, Upper Sauk, Suiattle, North Fork Stillaguamish, South Fork Stillaguamish; Southern Basin: Duwamish-Green, Puyallup, White, Nisqually). Although concerns remain regarding low abundance of five of the six populations in the remaining three regions, analysis indicated conduct of the Puget Sound salmon fisheries will have little to no effect on the ability to achieve rebuilding criteria for most of the populations in these regions. The exploitation rate in Puget Sound fisheries for four of these populations is anticipated to be 7 percent or less with the remaining 93 percent or more of harvest occurring in Canadian fisheries (NOAA Fisheries 2004c; NOAA Fisheries 2004d).

High harvest rates were also cited as a factor for decline of Hood Canal summer chum salmon. The state and tribal harvest comanagers adapted and improved harvest management strategies in response to improved information on stock status since the early 1990s. As a result, total exploitation rates have decreased over 90 percent from rates in the 1980s.

Since 1999, the comanagers and NOAA Fisheries have worked together on the development of a harvest management plan that would also address ESA goals. The plan was approved by NOAA Fisheries for long-term implementation in 2001. The plan's harvest strategies are designed to assist in the restoration of self-sustaining summer chum populations. The plan establishes an annual fishing regime (called the Base Conservation Regime) for Canadian and Washington fisheries, which is designed to minimize incidental impacts to summer chum salmon, while providing opportunity for fisheries conducted for other species. Many of the harvest restrictions incorporated in the Base Conservation Regime have been initiated in recent years. Specific monitoring programs have been established to improve stock assessment methodologies, as well as effectiveness of harvest management actions. These procedures include monitoring hatchery contribution to natural spawning populations, data collection of size and age of spawners, better assessment of the productivity of the various watersheds, evaluation of enforcement efforts. The comanagers have also implemented area, time, and gear restrictions to maximize harvest opportunity on other salmon species while minimizing impacts to listed summer chum. Among others, these actions include complete closure of most terminal fisheries, non-retention of summer chum, and gear restrictions (WDFW and PNPTT 2000). This management strategy is expected to result in an average 10.9 percent total annual harvest of Hood Canal stocks and an 8.8 percent total annual harvest of Strait of Juan de Fuca stocks.

Since the ESU was listed in 1999, Hood Canal summer-run chum salmon escapements have been stable or increasing for populations in both regions, an apparently positive response to the decline in exploitation rates, in combination with other factors (PNPT/WDFW 2004 [2003 Postseason Report]). Recent years' average escapements for all populations have been above their critical escapement thresholds, although the Jimmycomelately population has been below its critical escapement threshold in one of the last three years. Exploitation rates since the adoption of the management plan have averaged 2 percent or less for all populations in the ESU except the Quilcene, which is managed for an escapement goal that has been met every year since 1996 by a substantial margin. The pattern of low exploitation rates is expected to continue for the foreseeable future.

***Natural Conditions:*** Recent declines in fish populations in Puget Sound may reflect increased predation and recent climatic shifts. NOAA Fisheries has noted that predation by marine mammals has increased as marine mammal numbers, especially harbor seals (*Phoca vitulina*) and California sea lions (*Zalophus californianus*) increase on the Pacific Coast (NOAA Fisheries 2003a). In addition to predation by marine mammals, 33 fish species and 13 bird species have been reported to be predators of juvenile and adult salmon, particularly during freshwater rearing and migration stages (NOAA Fisheries 2003a).

Changes in climate and ocean conditions happen on several different time scales and have had profound influence on distributions and abundances of marine and anadromous fishes. Recent evidence suggests that marine survival among salmonids fluctuates in response to 20 to 30 year cycles of climatic conditions and ocean productivity (NOAA Fisheries 2003a). Although recent climatic conditions appear to be within the range of historical conditions, the risks associated with climatic changes are probably exacerbated by human activities (NOAA Fisheries 2003a).

***Conclusion:*** The picture of whether the biological requirements of Puget Sound Chinook and Hood Canal summer chum are being met is clear-cut for habitat-related parameters and for population factors; given all the factors for decline, even taking into account the corrective measures being implemented, it is clear that their biological requirements are currently not being met under the environmental baseline. Their status is such that there must be a significant improvement in the environmental conditions of the species' respective habitats (over those currently available under the environmental baselines). Any further degradation of the environmental conditions would have a significant impact due to the amount of risk the species presently face under the environmental baselines.

**Effects of the Action**

Caspian terns feed on a wide variety of fish including marine and freshwater species, and juvenile anadromous salmonids. Mixed stocks, naturally spawned, and hatchery stocks make for a mingled Puget Sound Chinook population that rears and migrates through the project area.

Roby et al. (2004) reported that the diet of Caspian terns nesting at Dungeness Spit was dominated by surfperch and juvenile salmonids in 2004: juvenile salmonids comprised 31.3 percent of the identified prey items. Roby et al. (2004) also reported that Chinook salmon, coho salmon, and steelhead were the most likely salmonid prey types for Caspian terns foraging at the Dungeness River mouth due to the large size (range ~100 – 200 mm) of these smolts during their outmigration. Roby et al. (2004) considered chum salmon outmigrants from the Dungeness River to be less likely to occur in the diet of Caspian terns at Dungeness Spit due to their tendency to leave the natal stream immediately post-emergence and their small size (range ~20 – 40 mm). However, it can be safely assumed that juvenile chum salmon rear in the vicinity of Dungeness Spit and attain a size during the course of the summer that falls within the length range of fish taken by Caspian terns.

The large system of inlets, bays, and canals within Puget Sound provide a diversity of rearing habitats for young salmon. For example, Beamish et al. (1998) and Sweeting et al. (2003), as cited in Roby et al. (2004) have documented that large numbers of coho, Chinook, and chum salmon are still present in Puget Sound throughout the summer, fall, and early winter months. Roby et al. (2004) stated: "A variety of salmonid species and evolutionarily significant units (ESUs) are potentially susceptible to predation from Caspian terns nesting at Dungeness Spit. At least nine different salmonid ESUs have been documented in Dungeness Bay or in the nearby Strait of Juan de Fuca (Beamish 1998; Sweeting et al. 2003): (1) Puget Sound Chinook salmon *(O. tshawytscha)*, (2) Even-year pink salmon (*O. gorbuscha*), (3) Odd-year pink salmon, (4) Hood Canal chum salmon (*O. keta*), (5) Puget Sound/Strait of Georgia chum salmon, (6) Puget Sound/Strait of Georgia coho salmon (*O. kisutch*), (7) Puget Sound steelhead (*O. mykiss*), (8) Puget Sound bull trout/dolly varden (*Salvelinus* spp.), and (9) Puget Sound sea-run cutthroat trout (*O. clarki*). Sockeye salmon (*O. nerka*) are also present in the Strait of Juan de Fuca, but are not currently identified with a particular ESU." Cutthroat, lingcod, and Dolly Varden also rear in Dungeness Bay (Personal communication, Matthew Longenbaugh). Thus, juveniles of a variety of species, in addition to Puget Sound Chinook and Hood Canal summer-run chum salmon, are available as prey for Caspian terns that nest at Dungeness NWR.

***Potential Take Estimate:*** An accurate take estimate is difficult to obtain because sufficient data from this Caspian tern colony has not been collected to produce this estimate. A gross estimate of the number of juvenile salmonids that could be consumed by Caspian terns at Dungeness NWR in 2004 can be generated using data from the East Sand Island Caspian tern colony (2000 - 2004) in combination with data from Roby et al. (2004) for the Dungeness NWR tern colony (see Appendix Table 1 for derivation of estimate). This estimate assumes that size of prey items in the two locations is comparable and the percentage of juvenile salmonids in the diet of terns nesting at Dungeness remains comparable to that observed in 2004. For 2000 - 2004, the Caspian tern colony at East Sand Island was estimated to consume approximately 1,000 total fish (range - 837 to 1084 fish) across species during the breeding season. The average number of fish consumed and the range of fish consumed at East Sand Island were then used to assess salmonid consumption at Dungeness NWR.

In 2004, 31.3 percent of the tern diet at Dungeness NWR was comprised of juvenile salmonids and the population of terns was estimated at 422 to 586 adults. Thus, we estimate 132,086 -183,418 (range - 117,000 to 199,000) juvenile salmonids could have been consumed by terns in 2004. Consumption levels of specific salmonid species or ESU is not possible based on current available information. The projected tern colony size at this site after management actions have been implemented would be in the lower to mid- range of historic numbers found on the Washington coast (100 to 3,500 pairs, USFWS et al. 2004). For this analysis, we are using the projected colony size of 1,000 pairs (or 2,000 adults). Thus, potential consumption for the maximum population estimate of terns (2,000 adults) is estimated at 627,000 (range: 555,000 to 679,000) juvenile salmonids annually. This would be an increase of approximately 443,000 to 494,000 (range: 438,000 to 535,000) juvenile salmonids consumed as compared to 2004. Although the percent composition by species of juvenile salmonids consumed by Caspian terns at Dungeness Spit is unknown, there is a likelihood that juvenile Puget Sound Chinook and Hood Canal summer-run chum salmon are present within foraging range of the tern colony. Thus, it is likely that Caspian terns would consume some listed juveniles.

**Effects Determination**

It is our determination that the proposed action will adversely affect Puget Sound Chinook and Hood Canal Summer-run chum salmon because some amount of salmon are expected to be consumed by terns. However, since the Dungeness Spit Area contains a large diversity of fish species (marine and nine salmonid ESUs), we expect the total number of listed salmonids consumed to be substantially less than the estimated increase of approximately 443,000 to 494,000 (range: 438,000 to 535,000) as compared to 2004 that could be consumed by terns. The proposed project will have no impact to any designated critical habitat.

***Conservation Measures***

1. We propose to monitor the diet of the Caspian tern colony at Dungeness NWR for two additional years (2005 and 2006) through observational data collection as conducted in 2004. This will provide a three-year data set upon which to base management decisions.

## Fern Ridge Lake, Oregon

**Project Description**
A 1-acre island is proposed for construction to provide nesting habitat for Caspian terns at Fern Ridge Lake. Island construction would occur during the fall-winter (e.g., October through end of January) timeframe to take advantage of annual drawdown for flood storage. Hardened roadbeds, i.e.,, former county roads now within the pool boundaries, would be used to access the site during the construction period. These roadbeds have previously been used for hauling materials for construction of a dike adjacent to the proposed island location, thus their capabilities to handle heavy construction traffic are known.

The island's location in open lake waters necessitates that riprap be used to armor the shoreline to prevent wave erosion of island materials. It is estimated that Class III riprap would be sufficient for shoreline armoring and would be used as a shell around the island. Quarry waste and/or material borrowed from the dry bed of the reservoir adjacent to the island location would be used to form the bulk of the island. Borrowed material would be tested for contaminants prior to excavation. A six-inch lift of 1.5 inch minus would be placed atop the quarry waste/borrow material and a one-foot layer of sand/pea gravel placed atop the 1.5 inch minus to provide nesting substrate for Caspian terns. Sand/pea gravel, gravel and rip rap can be obtained locally from gravel companies.

The project island location in the lake is at an average elevation of 369 feet. Full pool occurs at elevation 373.5 feet with flood storage potential to elevation 375.1 feet. It is proposed to construct the island to at least elevation 376 feet initially and concede that some settling of base material will occur. This should keep the island surface well above normal full pool elevation. Flood storage surcharge to elevation 375.1 feet is very unusual and would be short-term in nature with such events typically occurring in winter.

The proposed island would be square with side dimensions of approximately 208.7 feet at its crest. Island shape is for simplicity of construction. Approximately 5.5 feet of base fill would equate to 8,872 cubic yards (cy) of quarry waste/borrow material from the lakebed. A six-inch lift of 1.5 inch minus rock would be placed atop quarry rock to prevent sand from sifting downward into the base material; this equates to 807 cy. A one-foot sand layer would require 1,613 cy of material. Revetment yardage is 800 cy of Class III stone.

Future O&M requirements to maintain Caspian tern nesting habitat at the Fern Ridge Lake Island are anticipated to be minimal. Shoreline revetment would be installed to prevent erosion from wave action and is expected to have a greater than 50-year project life. A sand surface material may require periodic replenishment due to wind erosion; use of pea gravel would negate wind-erosion of surface material. Replacement material could be placed as needed in fall or winter after drawdown occurs. It is anticipated that weeds would have to be removed from the site annually, either by hand pulling or spot application of herbicide (Rodeo). There are no ESA species under NOAA Fisheries jurisdiction within Fern Ridge Lake.

Avian research activities may occur at the Fern Ridge Lake nesting island during the course of the Caspian tern management actions, if the tern colony reaches a size (e.g., 500 pairs) identified in the EIS Adaptive Management and Monitoring Plan (to be completed after the EIS is finalized) that would trigger research actions. Should research activities occur, they would entail researchers accessing the island location from late March into September via boat. Most research activity is accomplished from blinds. Certain research activities require personnel to be outside the blinds for extended periods of time.

**Biological Assessment**
Two federally listed salmonids under the jurisdiction of NOAA Fisheries may occur in the vicinity of the proposed project at Fern Ridge Lake. These include the threatened Upper Willamette River Chinook Salmon and Upper Willamette River steelhead.

***Status of Species***
The Upper Willamette River (UWR) Chinook salmon ESU is listed as threatened under the ESA ([64 FR 14308]). There are no direct estimates of total natural-origin spawner abundance for the UWR Chinook ESU. The abundance of the aggregate run passing Willamette Falls has remained relatively steady over the past 50 years (ranging from approximately 20,000 to 70,000 fish), but is only a fraction of peak abundance levels observed in the 1920s (approximately 300,000 adults) (NOAA Fisheries 2004b). Interpretation of abundance levels is confounded by a high but uncertain fraction of hatchery produced fish. The McKenzie River population has shown substantial increases in total abundance (hatchery origin and natural origin fish) in the last two years, while trends in other natural populations in the ESU are generally mixed (NOAA Fisheries 2004b). With the relatively large incidence of hatchery fish spawning in the wild, it is difficult to determine trends in productivity for natural-origin fish.

Seven artificial propagation programs in the Willamette River produce fish that are considered to be part of the UWR Chinook salmon ESU. All of these programs are funded to mitigate for lost or degraded habitat and produce fish for harvest purposes. During its 2004 Status Review, NOAA Fisheries' assessment of the effects of artificial propagation concluded that these hatchery programs collectively do not substantially reduce the extinction risk of the ESU (NMFS 2004a). An increasing proportion of hatchery-origin returns have contributed to increases in total ESU abundance (NOAA Fisheries 2004b). However, it is unclear whether these returning hatchery and natural fish actually survive over the summer to spawn. Estimates of pre-spawning mortality indicate that a high proportion (more than 70 percent) of spring Chinook in most ESU populations die before spawning (NOAA Fisheries 2004b). In recent years, hatchery fish have been used to reintroduce spring Chinook back into historical habitats above impassible dams (e.g., in the North Santiam, South Santiam, McKenzie, and Middle Fork Willamette rivers), slightly decreasing risks to ESU spatial structure (NOAA Fisheries 2004b). Within-ESU hatchery fish exhibit different life-history characteristics from natural ESU fish. High proportions of hatchery-origin natural spawners in remaining natural production areas (i.e.,, in the Clackamas and McKenzie rivers) may thereby have negative impacts on within- and among-population genetic and life-history diversity (NOAA Fisheries 2004b). Collectively, artificial propagation programs in the ESU have a slight beneficial effect on ESU abundance and spatial structure but neutral or uncertain effects on ESU productivity and diversity (NOAA Fisheries

2004a). Protective efforts, as evaluated pursuant to the PECE, did not alter the assessments of the BRT and the Artificial Propagation Evaluation Workshop participants voted that the ESU is "likely to become endangered within the foreseeable future." The USFWS Greenspaces Program, the Oregon Plan, hatchery reform efforts, and other protective initiatives are encouraging signs. However, restoration efforts in the ESU are very local in scale and have yet to provide benefits at the scale of watersheds or at the larger spatial scale of the ESU (NOAA Fisheries 2004b). The blockage of historical spawning habitat and the restriction of natural production areas remain to be addressed.

The Upper Willamette River (UWR) steelhead ESU is listed as threatened under the ESA ([64 FR 14517]). In its 2004 status review, NOAA Fisheries noted that approximately one-third of the UWR steelhead ESU's historically accessible spawning habitat is now blocked (NOAA Fisheries 2004a). Notwithstanding the lost spawning habitat, the ESU continues to be spatially well distributed, occupying each of the four major subbasins (the Molalla, North Santiam, South Santiam, and Calapooia rivers) (NOAA Fisheries 2004b). There was some uncertainty about the historical occurrence of steelhead in drainages of the Oregon Coastal Range. Coastal cutthroat trout is a dominant species in the Willamette basin, so steelhead are expected to have been less widespread in this ESU, occupying predominately the east side of the basin (NOAA Fisheries 2004b).

**ARRIVAL TIMES OF JUVENILE SALMONIDS AND NESTING PERIOD OF CASPIAN TERNS AT FERN RIDGE LAKE, OREGON.**

| | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEPT |
|---|---|---|---|---|---|---|---|---|
| UPPER WILLAMETTE RIVER CHINOOK | | | | | | | | |
| UPPER WILLAMETTE RIVER STEELHEAD | | | | | | | | |
| CASPIAN TERNS | | | | | | | | |

***Presence, abundance, and habitat use in Project Area***

***Upper Willamette River Chinook:*** Fisher and Hinrichsen (2004) report that the preliminary geometric mean aggregate abundance of UWR chinook salmon in the Clackamas and McKenzie rivers is equal to 12,530 for 2001 to 2003 compared to 3,041 in 1996 to 2000, a 312 percent increase. The slope of the aggregate population trend increased 15.2 percent (from 0.89 to 1.02) when the data for 2001 to 2003 were added to the 1990 to 2000 series, reversing the decline and indicating that, at least in the short-term, the aggregate population has been increasing.

Wild spring Chinook inhabit the McKenzie River with an estimated 3,428 adults above Leaburg Dam in 2002 (Schroeder et. al. 2003). Wild spring Chinook are probably extinct in the Middle Fork Willamette River that begins at approximately Willamette River mile 187. Wild progeny of this ESU are thus expected to only occur from the McKenzie River. Annual production of wild spring Chinook from the McKenzie River are unknown although at a 1 to 2 percent adult return rate, perhaps 171,000 to 343,000 juveniles outmigrated from the McKenzie River to produce the 2002 adult population. The number of juveniles outmigrating to produce a specific number of adults is complicated as adults returning may be 3 (jacks), 4, 5 or 6 years old, thus adult returns are not generated from just one year class. Hatchery fish typically return as 4 year olds whereas naturally produced fish typically return as 5 year olds.

Fry migration, from natural production in the McKenzie River system, to rearing areas in the lower McKenzie, mainstem Willamette, and lower Columbia rivers occurs in late January through February (C. Willis, pers. comm.). Most of these fish rearing in the mainstem Willamette River will leave the river by May when water temperatures increase and flow decreases (C. Willis, pers. comm.), however the mainstem Willamette River upstream of Albany is considered suitable for instream rearing by this component of juvenile spring Chinook (ODFW 2001). This segment of the population rearing in the lower McKenzie and mainstem Willamette rivers are initially approximately 0.75 - 1.5 inches in length. A fall migration of the larger (4 to 6") wild subyearling spring Chinook will occur from these stream segments in October to December (C. Willis, pers. comm.). An analysis of fork length data (ODFW unpub. data, 1993 to 1998) for juvenile spring Chinook (assumed to be wild) captured in August in the mainstem Willamette River from Marshall Island (RM 170) to the mouth of the McKenzie River (RM 176) demonstrated that juveniles ranged between 4 – 5 inches in fork length at that time. Yearling juveniles 2 to 5" in length from natural production overwinter and migrate in March and April to the ocean.

Hatchery production greatly supplements the number of juvenile salmonids moving through the McKenzie and Willamette Rivers in the Eugene area (ODFW 2004). Approximately 650,000 spring Chinook are released in late October to mid-November in the Middle-fork Willamette and McKenzie Rivers. Another 938,000 are released in those streams in early February. And approximately 1,196,000 spring Chinook are released in early March in the Middle-fork and McKenzie Rivers plus Fall Creek, a tributary of the Middle-fork Willamette River.

ODFW hatchery operation plans for Willamette, Leaburg and McKenzie Hatcheries (2004) states: "Rearing and release strategies are designed to limit the amount of ecological interactions occurring between hatchery and naturally produced fish. Fish are reared to sufficient size that smoltification occurs within nearly the entire population, which will reduce the retention time in downstream migration. Rearing on parent river water, or acclimation to parent river water for several weeks is used to ensure strong homing to the hatchery, thus reducing the stray rate to natural populations. Various release strategies are used to ensure that fish migrate from the hatchery with least amount of interaction with native populations."

***Upper Willamette River steelhead:*** Listed as a threatened species on March 25, 1999, the Upper Willamette River steelhead ESU includes all naturally spawned populations of winter-run Steelhead Trout in the Willamette River, Oregon and tributaries of the Willamette upstream, from Willamette Falls to the Calapooia River, inclusive.

Of the three runs of steelhead currently found in the Upper Willamette River ESU, only the late-run winter steelhead is considered to be native (Myers *et al.* 2003). Winter steelhead are only considered native to the eastside tributaries draining the Cascade Range. Most of the populations of winter steelhead have a large introduced component. While counts at Willamette Falls have increased in the last three years, the overall trend of winter steelhead is declining in the last 30 years (McElhany 2003b). The North and South Santiam subbasins have the only core and genetic legacy populations of winter steelhead in the Upper Willamette Basin (McElhany *et al.* 2003).

While there is little historical information on the population status of upper Willamette River winter steelhead, the geographic range and historical abundance are believed to be relatively small in comparison to the range and abundance of other steelhead ESUs. The current production of winter steelhead probably represents a larger proportion of historical production than is the case in other Columbia Basin ESUs (Busby *et al.* 1996). The limited data on winter steelhead adult escapement appear to indicate a declining population. Of the three winter steelhead subpopulations that have adequate adult escapement information to compute trends, the populations range from a 4.9 percent annual decline to a 2.4 percent annual increase. However, none of these winter steelhead population trends is significantly different from zero, indicating the precarious status of the stock. Historically, there were probably five demographically independent populations of winter steelhead in the Upper Willamette River winter steelhead ESU, all of which are associated with eastside tributaries (McElhany *et al.* 2003).

The historical run size of winter steelhead native to the Calapooia River has not been estimated. Annual sport catch in the Calapooia River watershed ranged from 0 to 122 fish during 1977 to 1988 (Weavers *et al.* 1992b). No estimates of historical (pre-1960s) abundance specific to this ESU are available. Total recent 5-year average run size for this ESU can be estimated from counts at Willamette Falls for the years 1989 to 1993. Dam counts indicate that the late-run (native) winter steelhead average run size was approximately 4,200, while early-run winter and summer steelhead averaged 1,900 and 9,700, respectively. Juveniles spend from 1 to 7 years in freshwater. For the Willamette River, the downstream limit for rearing of juvenile Chinook salmon is considered to be Albany, Oregon. The Calapooia River empties into the Willamette River at Albany, Oregon. The Calapooia River has low flow volume during the summer months, and based upon aerial photography, only the reach near the mouth has exposed surface waters. Upstream reaches east of Peoria and northeast of Halsey depict a riparian zone that canopies over the stream. Field observations in this area west of Interstate 5 also indicate a low volume, fairly stagnant stream that is unlikely to support juvenile steelhead. Conditions suitable for juvenile steelhead to rear in the Calapooia River are most likely to occur east of Brownsville (east of Interstate 5) and into the headwaters of the river. Aerial photos depict riffles, pools, and gravel bars occurring from approximately Brownsville upstream.

***Environmental Baseline***

The Willamette River basin historically provided important spawning and rearing grounds for large numbers of the spring Chinook salmon in the Columbia River basin. It has been estimated that the spring Chinook salmon run in the 1920s may have been five times the 55,000 fish counted in 1947 (NOAA Fisheries 2004b). From 1946 to 1951, annual spring Chinook runs, including the mainstem Willamette River sport catch, escapement above Willamette Falls, and escapement to the Clackamas River, ranged from 25,100 to 96,800 fish (NOAA Fisheries 2004b). Mean annual run size for this same period averaged 55,600, which was more than half the 97,543-fish run size that passed Bonneville Dam in 1948 (NOAA Fisheries 2004b). In 2003 and 2004, more than 100,000 adult spring Chinook crossed Willamette Falls each year. More than 85 percent of these fish were of hatchery origin. The average run size in the last 50 years has been around 40,000, with peaks as low as 11,000. The largest run on record was 156,033 adults in 1953 (NOAA Fisheries 2004b).

Historically, there were seven demographically independent populations of spring Chinook salmon in the Upper Willamette River Spring Chinook Salmon ESU: Clackamas, Molalla, Calapooia, North Santiam, South Santiam, McKenzie, and Middle Fork Willamette - all eastside tributaries (NOAA Fisheries 2004b). Today, five core populations survive in the Clackamas, North Santiam, South Santiam, McKenzie and Middle Fork Willamette subbasins, which historically sustained large populations and may have the intrinsic capacity to sustain large populations into the future (NOAA Fisheries 2004b). In addition to these core populations, the McKenzie subbasin population represents an important element of the genetic legacy of the Upper Willamette ESU. The McKenzie spring Chinook salmon population has been the least influenced by intra- or inter-basin transfers of hatchery stocks and probably has retained a relatively high degree of adaptation to local watershed conditions. It is thought that the Molalla and Calapooia spring Chinook salmon populations have been extirpated, or nearly so (NOAA Fisheries 2004b). Above Willamette Falls, native spring Chinook declined in abundance and distribution after the construction of the Willamette Valley dams. In the 1940s, state biologists surveyed the middle and upper basin and estimated that nearly 48 percent of the spring Chinook spawning habitat would be lost with construction of the dams in the McKenzie, Santiam, and Middle Fork Willamette rivers (NOAA Fisheries 2004b). Notably, only 400 miles of spawning and rearing habitat remain today (NOAA Fisheries 2004b). Changes in water temperature regimes from the dams have affected Upper Willamette spring Chinook spawn timing.

Of the three runs of steelhead currently found in the Upper Willamette River ESU, only the late-run winter steelhead is considered to be native (NOAA Fisheries 2004b). Winter steelhead are only considered native to the eastside tributaries draining the Cascade Range. There are no hatchery winter steelhead currently being released in the ESU. While counts at Willamette Falls have increased in the last three years, the overall trend of winter steelhead has been declining in the last 30 years (NOAA Fisheries 2004b). The North and South Santiam subbasins have the only core and genetic legacy populations of winter steelhead in the Upper Willamette basin (NOAA Fisheries 2004b).

While there is little historical information on the population status of upper Willamette River winter steelhead, the geographic range and historical abundance are believed to be relatively small in comparison to the range and abundance of other steelhead ESUs. The current production of winter steelhead probably represents a larger proportion of historical production than is the case in other Columbia Basin ESUs (NOAA Fisheries 2004b). The limited data on the proportion of winter steelhead that distribute themselves among the rivers upstream appear to indicate a declining population. Of the three winter steelhead subpopulations about which there is adequate information to compute trends, the populations range from a 4.9 percent annual decline to a 2.4 percent annual increase (NOAA Fisheries 2004b). However, none of these winter steelhead population trends is significantly different from zero, indicating the precarious status of the stock. Historically, there were probably four or five demographically independent populations of winter steelhead in the Upper Willamette River winter steelhead ESU, all of which are associated with eastside tributaries (NOAA Fisheries 2004b).

***Habitat:*** In general, human influences associated with forestry, farming, grazing, road construction, mining, and urbanization have all contributed to the decline of the listed species and their habitat. The fact that there have been a multitude of habitat degradations involving multiple dispersed actions poses a high risk to species recovery, especially since habitat degradations by their nature can only be remedied over time as the affected systems slowly recover their properly functioning condition.

A significant majority of the historical habitat for UWR ESUs has been eliminated by dams (NOAA Fisheries 2000). The remaining habitat available for anadromous fish occurs primarily in the lowland areas of the Willamette Valley. Most of the valley floor in privately owned and has been converted to agricultural use, with Douglas fir and Oregon white oak stands present in less-developed areas (NOAA Fisheries 2000). Irrigation is commonly employed, and stream flows, especially in the southern portion of this region, can be significantly affected. Agricultural and livestock practices contribute to soil erosion and fertilizer/manure deposition into stream systems.

Channel alterations (bank hardening, channel down-cutting, dredging, and isolating sloughs with cut-off dams) have resulted in the simplification of the once highly braided river system (NOAA Fisheries 2000). From 1870 to 1950, over 65,000 snags and streamside trees were pulled and cut up along the mainstem Willamette River (NOAA Fisheries 2000). This removal of woody debris represented an average of 550 snags per river kilometer. The average size of these snags ranged between 30 to 60 m in length and 0.5 to 2 m in diameter, with the cottonwoods the largest at up to 50 m long and 2 m in diameter.

Water quality is impacted by agricultural and urban activities. Many water quality problems are exacerbated by low water flows and high temperatures during the summer. Pulp and paper mill discharges of dioxin into the Columbia and Willamette Rivers were cited as another water quality concern, although this situation has been much more serious in the past (NOAA Fisheries 2000). Agricultural and urban operations have led to increases in pesticides, nutrients, trace elements, and organic compounds in the streams where anadromous fish reside. In addition, a six-mile stretch of the Lower Willamette River near Portland has been proposed as a federal Superfund site by the Environmental Protection Agency.

In the early 1920s, water tests by local and state agencies indicated that much of the lower Willamette River was heavily polluted by both municipal and industrial (primarily pulp and paper industries) wastes. A 1929 survey concluded that during summer low flow conditions, the dissolved oxygen levels in the lower Willamette River dipped to levels at or below 0.5 PPM (NOAA Fisheries 2000). Furthermore, these conditions continued for an additional 30 years before there was any detectable improvement in water conditions (NOAA Fisheries 2000).

Historically, spring Chinook populations existed in the smaller subbasins of the Willamette, such as the Molalla, Pudding, Thomas Creek, Crabtree Creek, Wiley Creek, Coast Fork, and Row River (NOAA Fisheries 2000). Habitat loss and degradation are the primary factors leading to the extinction of these natural-origin populations and currently limit the reestablishment Chinook in these areas (NOAA Fisheries 2000). However, in the future, with substantially reduced harvest rates and improved artificial propagation techniques, reintroduction into these habitats might be feasible.

Due to the significant changes in habitat quality discussed above, the fish community has changed dramatically in the Willamette basin. A USGS study of water quality in the Willamette Basin found fish community conditions that were characteristic of degraded and polluted systems and ranked among the poorest 25 percent of streams sampled in the U.S. by the National Water Quality Assessment program (NOAA Fisheries 2000). At one of the agricultural sites sampled in this study (Molalla Subbasin), 99 percent of the fish were non-native, pollution tolerant species and 61 percent of the fish exhibited external anomalies (NOAA Fisheries 2000).

***Hatcheries:*** The number of naturally produced UWR Chinook in the Clackamas above North Fork Dam and the McKenzie above Leaburg Dam has shown improvements in recent years, and these areas represent the stronghold spawning areas for the ESU (NOAA Fisheries 2004a). However, even in the Clackamas and McKenzie rivers, a substantial number of the spawners are of hatchery origin, which confounds the assessment of whether these two populations are in fact self-sustaining. It is unknown if the hatchery programs will be successful at reintroducing spring Chinook above the impassable dams back into historical habitat, given the downstream and upstream passage constraints (NOAA Fisheries 2004a).

The elimination of winter steelhead programs using Big Creek stock (out of ESU) benefited the conservation of the UWR steelhead ESU. However, there is still concern about the impacts from the non-native summer steelhead hatchery programs and the intermixing of summer and winter fish on the spawning grounds (NOAA Fisheries 2004a).

***Harvest:*** Harvest of Willamette spring Chinook in commercial and recreational fisheries prior to the ESU being listed in 1999 was moderately high. The average total harvest mortality rate was estimated to be 72 percent in 1982 to 1989, with a corresponding ocean exploitation rate of 24 percent (64 FRN 14308, March 24, 1999). In the 1990s, freshwater fishery impacts were lower due to poor returns of both hatchery and wild Chinook.

Since the listing in 1999, significant reforms have been implemented to help protect natural spring Chinook returning to the Willamette River. Selective fisheries that allow only hatchery fish to be harvested and require all wild fish to be released unharmed have been spreading throughout the Willamette basin since 1999. All rivers where spring Chinook fishing is allowed require all unmarked wild fish to be released. Reforms to ocean fisheries affecting Willamette Chinook have also occurred since 1999 under the Pacific Salmon Treaty. Ocean harvest rates are expected to continue to be in the range of 10 to15 percent under the new agreement.

These recent changes to fishery harvest have resulted in a more than 75 percent reduction in the mortality of wild spring Chinook returning to the Willamette ESU compared to pre-listing harvest rates (NOAA Fisheries 2000). Freshwater fishery impacts from commercial and recreational fisheries over the last few years have been in the range of 8 to 10 percent per population. The maximum cumulative harvest impact rate allowed under the Fisheries Management and Evaluation Plan (FMEP) approved under the ESA is 15 percent for each population. This FMEP is in effect indefinitely with regular evaluation of the management performance every five years.

Given the substantial reductions in fishery mortality and the certainty of continued implementation of these harvest restrictions into the future, ocean and freshwater fishery harvest is no longer a factor contributing to the decline or limiting the potential recovery of the Willamette spring Chinook ESU (NOAA Fisheries 2000). A more detailed explanation of this conclusion and supporting analyses is found in the FMEP (especially the quantitative life cycle model assessment in Appendix B of the FMEP). However, fisheries management will need to be continually evaluated to ensure this factor is not leading to the decline of the ESU.

Winter steelhead are caught primarily in freshwater recreational fisheries in the Lower Columbia and Willamette rivers. Prior to the early 1990s, natural-origin winter steelhead could be harvested. Since then, all returning hatchery steelhead have been externally marked, and fishing regulations require the release of all unmarked adult steelhead. Total mortality from fishing has been reduced from previous levels. Currently, mortality of listed winter steelhead is likely to be less than 5 percent of the returning run, which is the mortality associated with catch-and-release fishing (NOAA Fisheries 2000). Since 1997, Oregon has further reduced fishing impacts to juvenile winter steelhead in the Upper Willamette ESU by disallowing the retention of unmarked trout, eliminating put-and-take hatchery trout fisheries in streams, and prohibiting the use of bait while angling during the general trout season. These changes will likely reduce the mortality of juvenile steelhead. In addition, the hatchery steelhead program using Big Creek stock (non-ESU) has been eliminated to reduce incidental fishing mortality on listed steelhead and genetic introgression of this stock into the indigenous steelhead populations.

Impacts to listed species from fisheries have been reduced substantially since 1996. However, the benefits of these changes have not yet been realized. It is expected that listed populations will increase in abundance if fishing has been a limiting factor.

***Natural Conditions:*** Salmon and steelhead are exposed to high rates of natural predation, particularly during freshwater rearing and migration stages. Ocean predation may also contribute to significant natural mortality, although the levels of predation are largely unknown. In general, salmonids are prey for pelagic fishes, birds, and marine mammals, including harbor seals, sea lions, and killer whales. There have been recent concerns that the rebound of seal and sea lion populations, following their protection under the Marine Mammal Protection Act of 1972, has resulted in substantial mortality for salmonids. In recent years, for example, sea lions have learned to target UWR spring Chinook salmon in the fish ladder at Willamette Falls (NOAA Fisheries 2004b).

Changes in the abundance of salmonid populations are also substantially affected by the general pattern of a 30-year decline in ocean productivity. The mechanism whereby stocks are affected is not well understood. The pattern of response to these changing ocean conditions has differed among stocks, presumably due to differences in their ocean timing and distribution. It is presumed that survival is driven largely by events occurring between ocean entry and recruitment to a subadult life stage. One indicator of early ocean survival can be computed as a ratio of coded-wire-tag (CWT) recoveries of subadults relative to the number of CWTs released from that brood year. Time series of survival rate information for UWR spring Chinook, Lewis River fall Chinook, and Skagit fall Chinook salmon show highly variable or declining trends in early ocean survival, with very low survival rates in recent years (NOAA Fisheries 2004b).

***Conclusion:*** The Upper Willamette River basin has undergone substantial anthropogenic changes in the last 150 years. Loss of access to the majority of the historical spring-run spawning grounds due to dam construction, channelization of the mainstem Willamette River, and degradation in river water quality (especially in the Willamette Valley) has lead to the decline in anadromous fish populations in the basin.

Although the amount of available spawning habitat was reduced by the construction of dams, the remaining habitat is largely unsuitable due to the thermal and hydrological characteristics of the water discharged from the base of the dams.

Naturally spawning late-run winter steelhead exist in a number of major and minor tributaries to the Willamette River. Populations exist in the North and South Santiam River basins, with a remnant population in the Calapooia River. Additionally, there is a population in the Molalla River, although this may be descended from hatchery fish introduced from the North Santiam Hatchery. Small spawning aggregations of unknown origin also exist in the Pudding and Tualatin rivers. The loss of or degradation in their spawning, rearing, and holding habitat similarly affects steelhead and spring-run Chinook salmon.

Production within the existing habitat is likely to increase from that observed in the early 1990s. It is thought that the Pacific Northwest is shifting into a wet climatic regime which will likely increase production of fish in the freshwater and ocean environments (NOAA Fisheries 2000 ). The stream environment is also improving (higher streamflows, etc.) from the drought conditions that existed in the late 1980s and early 1990s (NOAA Fisheries 2000).

**Effects of the Action**

There currently is no suitable nesting habitat at Fern Ridge Lake for Caspian terns unless they choose to nest on mats of residual marsh vegetation. While black terns have nested on floating mats of marsh vegetation at Fern Ridge Lake, no incidence of Caspian terns nesting on this substrate have been recorded. Prey utilization by Caspian terns at Fern Ridge Lake are unknown at this time. Various species of the sunfish family (bass, crappie, etc.), carp and bullhead catfish are present and would be expected to comprise a significant proportion of the diet of terns at Fern Ridge Lake.

Caspian terns would be expected to occur at Fern Ridge Lake beginning in late March and remain at the colony site into August – early September each year. This colony is projected to be relatively small with a size range of 5 to 300 pairs (USFWS et al. 2004). Foraging by terns that colonize the Fern Ridge Lake site is expected to primarily occur in Fern Ridge Lake. Caspian terns could forage in the mainstem Willamette River and the McKenzie River, since both of these rivers are well within the tern's foraging range. The confluence of these streams is approximately 10 km from the proposed location of the tern colony at Fern Ridge Lake. Lyons (2004) determined that 50 percent of Caspian tern foraging activity occurred within 8 km of the colony location and 90 percent within 18 to 23 km for the Rice Island, lower Columbia River tern colony. Anderson (2003) determined that Caspian terns foraged an average of 20 km from the colony location.

The ODFW rearing and release strategy relative to Upper Willamette River spring Chinook is to minimize the retention time in downstream migration. This strategy is intended to limit interaction with native populations. Thus, most hatchery juveniles are expected to transit through the lower McKenzie River and the mainstem Willamette River relatively rapidly and not be available as prey for terns from the Caspian tern colony at Fern Ridge Lake. The release timing for hatchery spring Chinook (e.g., October to November, early February, early March) would greatly minimize the time when these released fish would be available to Caspian terns which are expected to begin arriving at Fern Ridge Lake at the end of March and to have left the area by October 1.

Juvenile wild Chinook salmon will rear in the lower McKenzie and mainstem Willamette Rivers within the foraging range of Caspian terns from the colony at Fern Ridge Lake. Initially, juvenile spring Chinook that move into the lower McKenzie and mainstem Willamette rivers will be less than three inches in length and would not be susceptible to predation by Caspian terns. Through the course of the spring and summer, a portion of these juveniles will attain lengths of 4 to 5 inches by August with a fall migration occurring of juveniles in the 4 to 6 inch range. Yearlings, ranging in length from 2 to 5 inches would emigrate in March and April, lessening their exposure to Caspian terns to a brief period when the terns have just arrived at Fern Ridge Lake.

The physical characteristics of the lower McKenzie and mainstem Willamette rivers will also influence Caspian tern predation. Shallow areas with rapid currents are not expected to be used by foraging Caspian terns. Pool areas or reaches of slower, deeper water should be the preferred foraging areas for Caspian terns. In-river habitat use by juvenile spring Chinook salmon will also influence their vulnerability to Caspian tern predation. Juvenile salmon utilization of areas with rapid currents, the head of pools where the surface water is strongly disturbed, and pool margins where overhead and/or underwater cover is present should limit vulnerability of juvenile spring Chinook to tern predation. The specific proportion of juvenile spring Chinook in the diet of Caspian terns nesting at Fern Ridge Lake cannot be ascertained prior to establishment of a tern colony at this site and implementation of diet studies. However, an estimate of Caspian tern consumption of juvenile wild spring Chinook salmon, predicated upon foraging observations at other locations and a number of general assumptions, can be derived.

The presence of alternative prey species in the mainstem Willamette and lower McKenzie rivers will temper predation on wild juvenile spring Chinook salmon. The Willamette River Basin Atlas (http://www.fsl.orst.edu/pnwerc/wrb/Atlas_web_compressed/PDFtoc.html) lists approximately 40 fish species in the Eugene area with native species comprising approximately 2/3rds of this total. Fish species in the mainstem Willamette River that represent a prey resource for Caspian tern include, but are not limited to: largescale sucker, mountain sucker, chiselmouth, northern pikeminnow, peamouth, mountain whitefish, rainbow trout, black crappie, bluegill, largemouth and smallmouth bass, white crappie, and common carp.

Another factor that will substantially limit the amount of predation incurred by juvenile spring Chinook in these streams is the small size, e.g., 5 to300 pairs, of the Caspian tern colony projected for Fern Ridge Lake. The colony is expected to take many years to build to the maximum projected size, which will allow time for prey composition studies to occur. Further, habitat conditions at the island developed for terns at Fern Ridge Lake can be reversed to make the site smaller and/or unsuitable for Caspian tern nesting if their predation on juvenile spring Chinook is determined to be a significant problem.

***Potential Take Estimate*:** The projected take of upper Willamette River spring Chinook is based in part upon the 2002 adult return of 3,428 adult salmon to the McKenzie River. We have assumed that a 1 to 2 percent survival rate of juvenile Chinook occurred to produce this adult return level. Thus, an estimated 171,000 to 343,000 juvenile Chinook comprised the outmigrant population leading to this adult return level. Further, an estimated 50 percent of these juveniles would have reared either upstream or downstream of the foraging range of Caspian terns originating from a tern colony at Fern Ridge Lake. Thus, 86,000 – 171,000 juvenile spring Chinook are expected to occur within the foraging range of this tern population.

Given that there is a relatively diverse prey base in Fern Ridge Lake and the Willamette and McKenzie rivers, we have assumed that the diet composition of Caspian terns would be spread across fish species comparable to that observed at the East Sand Island tern colony for the period of 2001-2004, when ocean conditions were favorable and a diverse assemblage of forage fish species were present and abundant. Salmonids averaged approximately 26 percent of the Caspian tern diet during that period at East Sand Island, and for purposes of estimation, that average is adopted to estimate take of juvenile salmonids (all species) for the Fern Ridge tern colony. The seasonal average of 1,000 fish (range – 837 to 1084) per breeding season per tern derived from the East Sand Island colony was also used for estimation purposes. We have also assumed that only 50 percent of the Fern Ridge tern population (i.e.,, 5 to 300 birds) would forage greater than 8 km from the colony or to the McKenzie and/or Willamette rivers. Thus, total juvenile salmonid consumption, regardless of species, for 300 birds (assumes maximum colony size of 600 terns or 300 pairs) is estimated at 78,000 (range: 65,286 to 84,552 juvenile salmonids). This estimate exceeds the number of juvenile wild spring Chinook forecast to be present within the foraging range of Caspian terns from a Fern Ridge Lake colony. However, the majority of juvenile salmonids that may be taken by Caspian terns are projected to be rainbow trout and mountain whitefish. These species are considered more abundant in the McKenzie and Willamette rivers than juvenile spring Chinook. Rainbow trout and mountain whitefish also should provide a larger prey item for Caspian terns than juvenile wild spring Chinook that have just outmigrated to the lower McKenzie and mainstem Willamette Rivers to rear at the time terns begin to arrive at Fern Ridge Lake. Data from two interior Oregon locations (Roby et al. 2003) suggest that salmonid consumption, e.g. trout for these two locations, was a relatively low proportion of the tern's diet. Terns at Summer Lake primarily preyed upon tui chub (74 percent) with trout representing almost 10 percent of their diet. The diet of Caspian terns at Crump Lake was more diverse with tui chubs (53 percent), centrarchids (27 percent), and catfish (15 percent) comprising the principal prey species by composition, whereas trout were a minor element (3 percent) of their diet. Centrarchids, catfish, carp and those species commonly referred to as chub (chiselmouth, peamouth, and northern pikeminnow) are generally abundant in the mainstem Willamette River, lower McKenzie River and/or Fern Ridge Lake. These data indicate that terns focus upon those fish species that are most abundant. We are assuming, in the absence an existing tern colony at Fern Ridge Lake and an associated evaluation of prey species composition, that Caspian terns at Fern Ridge Lake would have a diet composition of between 3 to 10 percent juvenile wild spring Chinook. This estimate is predicated upon the number and presumed abundance of alternative prey species in the area of Fern Ridge Lake and the percent of salmonids in the diet of Caspian terns at Crump and Summer lakes, Oregon. Thus, an estimated 2,340 to 7,800 (range: 1,959 to 8,455) juvenile spring Chinook salmon would be consumed by this population annually.

For Willamette River winter steelhead, the ability of Caspian terns to utilize this prey resource is quite different than for spring Chinook. The Brownsville reach of the Calapooia River is approximately 24 miles (38 km) in a straight line from the proposed colony location on Fern Ridge Lake. The principal foraging area for Caspian terns that colonize Fern Ridge Lake is expected to be the lake proper and the Willamette River secondarily where relatively abundant prey populations are considered present. The nearest reaches of the Calapooia River that may contain juvenile Upper Willamette River steelhead and some suitable foraging habitat for Caspian terns is approximately 24 miles distant from the colony location. Consequently, it is considered unlikely that Caspian terns would forage in the Calapooia River given the distance from the proposed colony location and the presence of two, closer bodies of water that support a more abundant and diverse array of prey species. Thus, it is projected that Caspian terns from the Fern Ridge Lake colony will take no juvenile upper Willamette River steelhead.

**Effects Determination**
The proposed development of a Caspian tern colony at Fern Ridge Lake will adversely affect Upper Willamette River Spring Chinook because some amount of salmon could be consumed by nesting terns. We estimate that approximately 2,340 to 7,800 (range: 1,959 to 8,455) juvenile Chinook could be consumed by terns. We expect the proposed action will have no effect on the Upper Willamette River steelhead ESU given their distance from the Fern Ridge colony and the likelihood that no juvenile steelhead will be taken by Caspian terns originating from the Fern Ridge Lake colony.

***Conservation Measures***

1. We propose to monitor the diet of the Caspian tern colony at Fern Ridge Lake for three years through observational data collection to determine diet composition relative to juvenile spring Chinook salmon once the colony exceeds 50 pairs and incidental observations suggest that spring Chinook may comprise more than 15 percent of their diet composition. This will provide a three-year data set upon which to base future management decisions.

## San Francisco Bay, California

Three locations are under consideration for habitat development to support nesting Caspian terns in the San Francisco Bay area. The locations under consideration are Brooks Island, Hayward Regional Shoreline, and Don Edwards National Wildlife Refuge.

**Project Description – Brooks Island**
The actions proposed at Brooks Island entail primarily vegetation removal and enhancement of the substrate. Vegetation removal includes hand or mechanical removal of non-native plants to provide a bare surface for nesting. Substrate enhancement may entail the addition of sand, pea gravel, or other suitable material for nesting Caspian terns. Predator control may also occur to facilitate maintenance of a Caspian tern colony at this location. Predator management is already implemented as needed to remove red foxes and raccoons or other comparable predators that consume eggs, young, and/or adult colonial nesting birds. Predator management associated with this proposed action falls within the current program design. Future O&M requirements to maintain Caspian tern nesting habitat at this site are anticipated to be minimal and include the above described actions as needed.

Avian research activities may occur at the Brooks Island location during the course of the Caspian tern management actions. Should research activities occur, they would entail researchers accessing the locations from early March into September via boat to the island and then walking to the colony site. Most of the research activity would be accomplished from a blind. Certain research activities require personnel to be outside the blinds for extended periods of time. Research activities would be coordinated with the East Bay Regional Parks District and a park permit will be acquired if necessary.

**Project Description – Hayward Regional Shoreline**
The actions proposed at Hayward Regional Shoreline entail removal of vegetation and enhancement of the substrate on existing islands within a series of tertiary wastewater treatment ponds. Management for Caspian tern habitat is proposed for 2 to 3 islands at this location. Water within these ponds includes a mixture of treated wastewater and bay water (salt water).

Vegetation management at this site could be accomplished via mechanical means, either light construction/agricultural equipment, and/or personnel using hand tools (no heavy equipment required) or covering the sites with filter fabric topped by layers of rock salt, then sand and oyster shell. Herbicides could be potentially used if necessary. Prior to the use of herbicides, reconsultation with NOAA Fisheries would be implemented. Management of vegetation is required in order to provide a bare surface for tern nesting. The site may also be saturated with salt water to inhibit future vegetation growth. Substrate enhancement may entail the addition of a filter fabric over the surface area of the island that would subsequently be covered with sand, pea gravel, or other suitable material for nesting Caspian terns. Sand and other materials would be transported to these islands via boat and/or helicopter. The proposed action is similar to previous enhancement action at these ponds done for California least terns, including spraying vegetation, laying down rock salt, covering the surface with fabric cloth, and finally laying down 110 tons of sand.

Social facilitation, i.e.,, the use of tern decoys and a sound-system for continuous playback of tern colony vocalizations, will also be used at this location. Predator management may also occur to facilitate establishment and maintenance of a Caspian tern colony at this location. Predator control is already implemented as needed at Hayward Regional Shoreline to remove red foxes and raccoons or other predators that consume eggs, young and/or adult birds of herons, egrets, Forster's terns, and shorebirds. Predator management associated with this proposed action falls within the current program design.

Future O&M requirements to maintain Caspian tern nesting habitat at the Hayward Regional shorelines are anticipated to be minimal and would include the above described actions as needed. Shoreline revetment would not be installed as the islands are within diked ponds. A sand surface material may require periodic replenishment due to wind erosion; use of pea gravel would negate wind-erosion of surface material. Replacement material could be placed as needed in fall or winter after terns and other nesting birds have finished nesting and probably left the area. It is anticipated that weeds would have to be removed from the site annually, either by hand pulling or spot application of herbicide.

Avian research activities may occur at the Hayward Regional Shoreline during the course of the Caspian tern management actions, if the tern colony reaches a size (e.g., 500 pairs) identified in the EIS Adaptive Management and Monitoring Plan (to be completed after the EIS is finalized) that would trigger research actions. Should research activities occur, they would entail researchers accessing the locations from early March into September via kayak or observations from the dike. Research activities would be coordinated with the East Bay Regional Parks District and a park permit will be acquired if necessary.

**Project Description – Don Edwards National Wildlife Refuge**

The actions proposed on Don Edwards NWR entail enhancement of the substrate on existing interior levees within Ponds N1/N9. These lie within active salt ponds currently managed by Cargill for salt production. Substrate enhancement may entail the addition of a filter fabric over the surface area of the levees that would subsequently be covered with rock salt, sand, pea gravel or other suitable material for vegetation control and/or suitable substrate for nesting Caspian terns. It will be necessary to do construction and O&M work between November and February or early March. Terns and other nesting birds start prospecting by mid-to-late March in the Bay Area. Social facilitation, i.e.,, the use of tern decoys and a sound-system for continuous playback of tern colony vocalizations, may also be used at this location. Predator control and/or gull harassment/control may also occur to facilitate establishment and maintenance of a Caspian tern colony at this location. Predator control is currently implemented as needed on the NWR to protect listed species. Typically red foxes and raccoons or other comparable predators consume eggs, young and/or adult birds or the clapper rail or snowy plover. Predator management associated with this proposed action falls within the current program design. Substrate enhancement and predator management would need to be repeated as needed in the future.

Future O&M requirements to maintain Caspian tern nesting habitat at the Don Edwards NWR are anticipated to be minimal. Shoreline revetment would not be installed as the islands occur within diked areas. A sand surface material may require periodic replenishment due to wind erosion; use of pea gravel would negate wind-erosion of surface material. Replacement material could be placed as needed in fall. It is anticipated that weeds would have to be removed from the site annually, either by hand pulling, light tillage, or spot application of herbicide. The interior levees where vegetation management would occur are not connected to San Francisco Bay except when the salt evaporation ponds are flooded and waters are strictly inlet to the site and not discharged. Thus, there is no potential for herbicide discharge to waters of the bay, where listed fish species occur.

Avian research activities may occur at the Don Edwards NWR during the course of the Caspian tern management actions, if the tern colony reaches a size (e.g., 500 pairs) identified in the EIS Adaptive Management and Monitoring Plan (to be completed after the EIS is finalized) that would trigger research actions. Should research activities occur, they would entail researchers accessing the locations from early March into September via kayak, foot and/or vehicle. Most research activity is accomplished from blinds. Certain research activities may require personnel to be outside the blinds for extended periods of time. Research activities would be coordinated with the Service and a refuge Special Use Permit will be acquired if necessary.

**Biological Assessment**

Five listed salmonid ESUs occur in San Francisco Bay and could be affected by the proposed action. These include: Central Valley steelhead, Central Valley spring-run Chinook, Sacramento winter-run Chinook, Central California Coast coho and Central California Coast steelhead

ARRIVAL TIMES OF JUVENILE SALMONIDS AND NESTING PERIOD OF CASPIAN TERNS IN SAN FRANCISCO BAY.

| | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG |
|---|---|---|---|---|---|---|---|---|
| CENTRAL VALLEY STEELHEAD | | | | | | | | |
| CENTRAL VALLEY SPRING-RUN CHINOOK | | | | | | | | |
| SACRAMENTO WINTER-RUN CHINOOK | | | | | | | | |
| CENTRAL CALIFORNIA COAST STEELHEAD | | | | | | | | |
| CENTRAL CALIFORNIA COAST COHO | | | | | | | | |
| CASPIAN TERNS | | | | | | | | |

***Status of Species***

***Central Valley Steelhead:*** The Central Valley (CV) steelhead ESU includes all naturally spawned populations of steelhead and their progeny in the Sacramento and San Joaquin rivers and their tributaries, excluding steelhead from the San Francisco and San Pablo bays and their tributaries. The ESU also includes artificially propagated steelhead stocks and their progeny from the Coleman National Fish Hatchery and Feather River Hatchery programs. Other anadromous hatchery steelhead stocks propagated within but not included in the ESU are those in the Nimbus Hatchery (Eel River stock) and the Mokelumne River Hatchery (out-of-basin composite stock) steelhead programs.

The CV ESU was listed as a threatened species on March 19, 1998 (63 FR 13347), due to the depressed numbers of naturally produced steelhead, the severe loss of habitat, the number of human-caused threats to the species (including hatchery impacts), and the lack of adequate regulatory protection to conserve the ESU. Historically, steelhead were well distributed throughout the Sacramento and San Joaquin Rivers (NOAA Fisheries 2004a). CV steelhead ESU abundance was estimated to be 40,000 fish in the 1960s, but estimates were reduced to less than 10,000 fish by 1992, based on past spawning surveys, hatchery returns, and dam counts (NOAA Fisheries 2004a). CV steelhead populations show a continuing population decline, an overall low abundance, and fluctuating return rates (BRT 2003). In the assessment of the ESU, two-thirds of the West Coast Salmon Biological Review Team (BRT) members voted for the category "in danger of extinction," and the remaining members voted for the "likely to become endangered" category (BRT 2003). The BRT expressed concerns about the increasing risks of the effects of artificial propagation on ESU abundance, productivity and spatial structure and the moderate but increasing risk to ESU abundance.

***Central Valley spring-run Chinook Salmon:*** This ESU includes all naturally spawned populations of spring-run Chinook salmon (and their progeny) in the Central Valley. Extant spring-run populations in the southern Cascades ecoregion include those in Mill, Deer, and Butte creeks (NOAA Fisheries 2004a). Spring-run populations of the northern Sierra ecoregion are found in the Yuba and Feather rivers.

The Central Valley spring-run (CVS) Chinook ESU was listed as threatened on September 16, 1999 (64 FR 50394), due to the loss of approximately 95 percent of historical spawning habitat, the severe degradation of remaining rearing and migration habitat, and the possible hybridization of spring- and fall-run Chinook salmon from operations at the Feather River Hatchery (NOAA Fisheries 2004a). Hydropower projects have impacted stream hydrology and barred access to cool, deep pools required by CVS Chinook for holding over in the summer. Unscreened water diversions, fish predation, and high water temperatures also continue to threaten CVS Chinook (NOAA Fisheries 2004a). The CVS Chinook ESU had been reduced from an estimated peak of 700,000 spawners ESU-wide to a range of 67 to 243 spawners per population by the mid-1980s (NOAA Fisheries 2004a). Only three out of 18 historical spring-run populations still exist. All of the San Joaquin River basin spring-run populations have been extirpated by the loss of their habitat, high water temperatures, and lack of flows (NOAA Fisheries 2004a).

More recent population estimates (years 2001 to 2003) for upper Sacramento River spring-run indicate increasing abundance for the Mill Creek (1,426), Deer Creek (2,759), and Butte Creek (4,398) populations. The 2003 estimates of spring-run in streams dependent upon migration from adjacent populations range from 25 to 94 fish (NOAA Fisheries 2004a). The long- and short-term trends for spring-run growth have been positive over the past five years (NOAA Fisheries 2004a). In their 2003 status review, a majority (69 percent) of the West Coast Biological Review Team (BRT) members voted that this ESU is "likely to become endangered," 27 percent voted that the ESU is "in danger of extinction," and 4 percent voted that listing was "not warranted" (NOAA Fisheries 2004a).

***Sacramento River winter-run Chinook Salmon:*** The Sacramento River winter-run (SRW) Chinook ESU consists of a single population composed of both natural-origin and hatchery-origin fish. Critical habitat for SRW Chinook salmon was designated on June 16, 1993 (58 FR 33212), and includes the Sacramento River from Keswick Dam (RM 302) downstream to Chipps Island (RM 0) at the westward margin of the Sacramento-San Joaquin Delta; all waters from Chipps Island westward to the Carquinez Bridge, including Honker Bay, Grizzly Bay, Suisun Bay, and Carquinez Strait; all waters of San Pablo Bay west of the Carquinez Bridge; and all waters of the San Francisco Bay (north of the San Francisco Bay Bridge) from San Pablo Bay to the Golden Gate Bridge.

SRW Chinook salmon originally were listed as threatened in November 1990 (55 FR 46515) and then reclassified as endangered in January 1994 (59 FR 440), due to the increased variability of run sizes, expected weak returns as a result of two small year classes in 1991 and 1993, and a 99 percent decline between 1966 and 1991. The SRW Chinook salmon ESU was originally composed of several populations that historically spawned in the headwaters of the McCloud, Pit, and Little Sacramento rivers and Hat and Battle creeks. A winter-run population that existed in the Calaveras River in the San Joaquin basin in the 1970s and 1980s has since been extirpated. Construction of Shasta Dam blocked access to all winter-run habitat in the upper watershed except for Battle Creek, a tributary of the Sacramento River (NOAA Fisheries 2004a). Most of the current winter-run Chinook salmon spawning and rearing habitat is between Keswick Dam and Red Bluff Diversion Dam in the Sacramento River. In the assessment of the SRW Chinook ESU, 59 percent of the West Coast Salmon Biological Review Team (BRT) members voted to list the ESU as "in danger of extinction," 38 percent voted to list it as "likely to become endangered," and the remaining 3 percent voted that listing was not warranted (NOAA Fisheries 2004a). The BRT expressed concerns regarding the effects of artificial propagation on ESU productivity, spatial structure, and diversity but believed that hatchery effects on ESU abundance were positive.

Redd and carcass surveys and fish counts suggest that the abundance of SRW Chinook salmon is increasing, but in the long term, the rate of increase is expected to decline. Recent SRW Chinook salmon abundance represents only 3 percent of the maximum post-1967, 5-year geometric mean and is not yet well established (NOAA Fisheries 2004a).

ESU productivity has been positive in the short term, and adult escapement and juvenile production have been increasing annually (NOAA Fisheries 2004a). The long-term trend for the ESU remains negative, as it consists of only one population, subject to possible catastrophic impacts from environmental and artificial conditions.

***Central California Coast Coho Salmon:*** The Central California Coast (CCC) coho ESU extends from Punta Gorda in northern California to the San Lorenzo River in Santa Cruz, California, inclusive of the San Francisco Bay basin. It includes all naturally spawned populations of coho salmon in accessible river and tributary reaches within the ESU and any coho salmon found spawning south of the San Lorenzo River that have not resulted from stock transfers from outside the ESU. Also included in the ESU are the artificially propagated coho salmon stocks (and their progeny) at both the Don Clausen Fish Hatchery and the Monterey Bay Salmon and Trout Project Kingfisher Flat Hatchery and its associated captive broodstock at the Southwest Region Fisheries Science Center. The Noyo River coho salmon stock, previously propagated at the Noyo River Fish Station, is also part of the ESU.

The CCC coho ESU was listed as a threatened species on October 31, 1996 (61 FR 56138), due to the depressed numbers of naturally produced coho salmon, the high risk of extinction for some populations, and the number of environmental and human-caused threats to the species, including hatchery impacts. State-wide estimates for California populations of coho salmon numbered between 200,000 and 500,000 in the 1940s (61 FR 56138). CCC coho abundance was estimated at 56,100 in 1963, reduced to 18,050 by 1985, and further reduced to 6,160 in the late 1980s, with many populations comprising fewer than 100 individuals (NOAA Fisheries 2004a). Habitat fragmentation and population declines in the ESU have resulted in small, isolated populations that face genetic risks from inbreeding, loss of rare alleles, and genetic drift. Based on the presence/absence data from 133 streams (72 percent of historical CCC coho salmon streams), 71 streams no longer have coho salmon runs. CCC Coho salmon stocks south of San Francisco have a greater risk of extinction than the northern coho salmon populations (NOAA Fisheries 2004a). More recent information confirms a high risk of extinction for the CCC coho ESU, specifically for populations of the Garcia, Gualala, and Russian rivers and tributaries of the San Francisco Bay (NOAA Fisheries 2004a). There are no viable statistical data available for ESU abundance. Based on an index of adult abundance from fish counts at the Noyo ECS, there is a significant decline of CCC coho salmon in the South Fork Noyo River beginning in 1977.

The ESU has undergone a steep decline in productivity, and the short- and long-term trends for the ESU are negative, though there have been positive trends in the last few years.

***Central California Coast steelhead:*** The Central California Coast (CCC) steelhead ESU includes all naturally spawned populations of steelhead in accessible river and tributary reaches within watershed basins from the Russian River (Sonoma County) to Aptos Creek, Santa Cruz County (inclusive) and the drainages of San Francisco and San Pablo bays eastward to the Napa River (inclusive) in Napa County, California. Also included in the ESU are the artificially propagated steelhead stocks (and their progeny) at the Don Clausen Fish Hatchery and the Monterey Bay Salmon and Trout Project (MBSTP) Kingfisher Flat Hatchery (BRT 2003).

The CCC steelhead ESU was listed as a threatened species on August 18, 1997 (62 FR 43937), due to the depressed numbers of naturally produced steelhead and the number of environmental and human-caused threats to the species. These included hatchery impacts and subsequent loss of population resiliency due to natural factors for decline (e.g., drought, poor ocean conditions, predation). Historical ESU abundances for the Russian and San Lorenzo rivers have been reduced by 85 percent, and many extant populations consisted of 500 fish or fewer. Nearly 75 small inland watersheds drain to the San Francisco Estuary. Historically, at least 70 percent of those watersheds once had steelhead runs, mainly in northern tributaries (Leidy et al. 2003). At present, remnant populations persist in 19 watersheds in the Estuary (San Francisco Estuary Project 2000). In a 1994 to 1997 survey of 30 San Francisco Bay watersheds, steelhead occurred in small numbers at 41 percent of the sites (Leidy 1997). A few tributaries in the southern San Francisco Estuary historically supported steelhead runs, but the effects of urbanization have resulted in the extirpation of several native fish species, including steelhead (Aceituno et al. 1976).

Currently, only four watersheds in the south bay support small populations of steelhead. More recent information includes a presence/absence compilation of steelhead in the CCC steelhead ESU, indicating that 82 percent of the sample streams across the ESU held *O. mykiss* juveniles (NOAA Fisheries 2004a). Statistical analysis conducted on the available juvenile data estimated a downward trend for five independent sites (the San Lorenzo River and Scott, Waddell, Gazos, and Redwood creeks). CCC steelhead ESU habitat has been impacted by the major passage barriers of Coyote and Warm Springs dams in the Russian River watershed, urban development, poor land-use management, and irrigation and water diversion impacts (NOAA Fisheries 2004a). Assessments by the BRT of the risks faced by the ESU were divided, with 69 percent of the BRT votes being cast for "likely to be endangered," 25 percent cast for "in danger of extinction," and the remaining 6 percent cast for "neither" (NOAA Fisheries 2004a). The BRT believed that artificial propagation contributed to population abundance, but members were unsure of hatchery effects on the unknown productivity, spatial structure, and diversity of the ESU.

There are no adequate abundance estimates for the Russian River, Scott Creek, and San Lorenzo River systems (NOAA Fisheries 2004a). Juveniles are reportedly widespread and abundant in the Russian River, Scott Creek, and the San Lorenzo River systems, but it is not known if productivity is at a viable level for ESU recovery (NOAA Fisheries 2004a).

***Presence, abundance, and habitat use in Project Area***

***Central Valley (CV) Steelhead:*** CV steelhead once ranged throughout most of the tributaries and headwaters of the Sacramento and San Joaquin basins prior to dam construction, water development, and watershed perturbations of the $19^{th}$ and 20th centuries. In the early 1960s, the California Fish and Wildlife Plan estimated a total run size of about 40,000 adults for the entire Central Valley including San Francisco Bay. The annual run size for this ESU in 1991to 92 was probably less than 10,000 fish based on counts at dams, hatchery returns, and past spawning surveys. At present, all CV steelhead are considered winter-run steelhead, although there are indications that summer steelhead were present in the Sacramento River system prior large-scale dam construction in the 1940s (NOAA Fisheries 2004e).

There appear to be no steelhead-bearing rivers in the Sacramento River Basin that have not received releases of multiple hatchery stocks. Major steelhead production facilities within the Central Valley include Coleman Fish Hatchery, Feather River Fish Hatchery, Mokelumne River Fish Installation, and Nimbus Hatchery. Each of these facilities has utilized steelhead stocks originating from within the basin as well as out-of-basin stocks; stock transfers between the Central Valley steelhead facilities have historically been commonplace. Since 1983, about 2.8 million juvenile steelhead have been released annually into the Sacramento River Basin (Busby et al. 1996). Currently at the Feather River Hatchery (the Feather River is a tributary to the Sacramento River), about 500,000 fish are released in-river per year (Feather River Hatchery 2004, pers. comm.) and about 600,000 in-river from the Coleman National Fish Hatchery (Coleman National Fish Hatchery 2004, pers. comm.). NOAA Fisheries, through their Biological Review Team process have estimated that 100,000 – 300,000 natural origin juvenile CV steelhead are produced (http://www.nwr.noaa.gov/AlseaResponse/20040528/ Steelhead4.pdf).

Juveniles live in freshwater from one to four years, then smolt and migrate to San Francisco Bay and the Ocean (NOAA Fisheries 2004e). The outmigration period is from December through June and fish rear extensively in the Bay. It is not known how long they remain in the Bay, and some fish might not go to the Ocean at all but rear entirely in the Bay before returning to their natal streams to spawn, typically as three or four year old fish (Calif. Dept. Fish and Game, pers. comm.). Outmigrants may utilize tidal marsh areas, non-tidal freshwater marshes, and other shallow water areas in the bays as rearing areas (NOAA Fisheries 2004e).

***Central Valley spring-run (CVS) Chinook salmon:*** This run once formed the dominant Chinook race in California (Clark 1929). Natural spawning populations of CVS Chinook salmon are currently restricted to accessible reaches in the upper Sacramento River, Antelope Creek, Battle

Creek, Beegum Creek, Big Chico Creek, Butte Creek, Clear Creek, Deer Creek, Feather River, Mill Creek, and Yuba River. With the exception of Butte Creek and the Feather River, these populations are relatively small ranging from a few fish to several hundred. Butte Creek returns in 1999, 2000, and 2001 numbered approximately 3,600, 4,118, and 9,605, respectively.

On the Feather River, significant numbers of CVS Chinook salmon, as identified by run timing, return to the Feather River Hatchery. However, coded-wire-tag information from these hatchery returns indicates substantial introgression has occurred between fall-run and spring-run Chinook salmon populations in the Feather River due to hatchery practices (NOAA Fisheries 2004e).

The most recent status review by California Dept. Fish and Game reports low population abundance of CVS Chinook salmon over many generations (NOAA Fisheries 2004e). Currently, it is estimated that about 1 to 2 million juvenile wild fish migrate out of freshwater and into San Francisco Bay per year (NOAA Fisheries 2004, pers. comm.).

The Feather River hatchery on the Feather River, a tributary to the Sacramento River, releases some fish. The majority of these fish are released outside the Feather River Basin (Myers et al. 1998). The Feather River Hatchery in 2004 released about 750,000 juvenile spring-run Chinook salmon in-river in 2004 and about the same amount at the upper end of the Bay at Carquinez Strait downstream of Chipps Island. Only about 10 to 15 percent of these fish are marked (Feather River Hatchery 2004, pers. comm.).

In Deer and Mill creeks, juvenile CVS Chinook salmon usually spend nine to ten months in their natal streams, although some may spend as long as 18 months in freshwater. Most "yearling" CVS Chinook salmon move downstream in the first high flows of the winter from November through January. In Butte and Big Chico creeks, CVS Chinook salmon juveniles typically exit their natal tributaries soon after emergence during December and January, while some remain throughout the summer and exit the following fall as yearlings (NOAA Fisheries 2004e).

The outmigration period is from March through April and into May. It is not known how long they remain in the Bay but it is believed that transit through the Bay to the Ocean is similar to that of fall Chinook salmon (not Federally listed) that take about 40 days to travel through the Bay to the Ocean and don't enter the south Bay. Fall Chinook salmon, and likely spring-run Chinook salmon, show no significant growth during their transit through the Bay (MacFarlane and Norton 2002; NOAA Fisheries 2004, pers. comm.).

***Sacramento River winter-run (SRW) Chinook salmon:*** Historically, SRW Chinook salmon were abundant in the McCloud, Pit, and Little Sacramento rivers. Construction of Shasta Dam in the 1940s eliminated access to all historic spawning habitat for SRW Chinook salmon in the Sacramento River Basin. Since then, the ESU has been reduced to a single spawning population confined to the mainstem Sacramento River below Keswick Dam; although some adult SRW Chinook salmon have been observed in recent years in Battle Creek, a tributary to the upper Sacramento River.

Quantitative estimates of run size are not available for the period prior to the completion of Red Bluff Diversion Dam in 1966. California Dept. Fish and Game estimated spawning escapement of SRW Chinook salmon at 61,300 (60,000 mainstem, 1,000 in Battle Creek, and 300 in Mill Creek) in the early 1960s, but this estimate was based on "comparisons with better-studied streams" rather than actual surveys. During the first three years of operation of the counting facility at Red Bluff Diversion Dam (1967 to 1969), the spawning run of SRW Chinook salmon averaged 86,500 fish. From 1967 through the mid-1990's, the population declined at an average rate of 18 percent per year, or roughly 50 percent per generation. The population reached critically low levels during the drought of 1987 to 1992; the three-year average run size for period of 1989 to 1991 was 388 fish. However, the trend in the past ten years indicates that the population is recovering. The most recent three-year (1999 to 2001) average run size based on carcass surveys by California Dept. Fish and Game was 6,804 fish (NOAA Fisheries 2004a).

The Winter-run Captive Broodstock Program was initiated in 1991 when the adult run size was estimated at only 191 fish and it was recognized that it might become impossible to secure wild adults for an artificial propagation program. This experimental program was designed because of the threat of a catastrophic cohort failure or extinction of the run in the wild. It was planned to be in operation for ten years.

Since its inception, the program has housed captive fish in at least two separate facilities. The project has exceeded its expected ten-year life span and recent changes have been made to facilitate the eventual close-out of the program. Originally, Steinhart Aquarium (San Francisco) and Bodega Marine Laboratory (Bodega Bay) each housed a portion of the broodstock. In 1998, Livingston Stone National Fish Hatchery also began holding winter-run captive broodstock. In 2001, Steinhart Aquarium terminated most of its participation in the program. All winter-run captive broodstock previously held at Steinhart were transported to Bodega Marine Laboratory. Currently, winter-run captive broodstock are held at Livingston Stone National Fish Hatchery and Bodega Marine Laboratory. Over the next several years, it is expected that all winter-run Chinook captive broodstock activities will be transferred to Livingston Stone National Fish Hatchery (California Dept. Fish and Game 2004b).

Currently, it is estimated that less than 100,000 juvenile wild fish migrate out of freshwater and into San Francisco Bay per year and about 250,000 hatchery fish are released in-river (NOAA Fisheries 2004, pers. comm.).

In the Sacramento River and other rivers, juveniles may begin migrating downstream almost immediately following emergence from the gravel with emigration occurring from December through March. Fry and parr may spend time rearing within riverine habitats including natal tributaries, the Sacramento River, non-natal tributaries to the Sacramento River, and the Delta. Fall and winter emigration behavior by juveniles varies with streamflow and hydrologic conditions. Most juveniles distribute themselves to rear in the Sacramento River through the fall and winter months. Some SRW Chinook salmon juveniles move downstream to rear in the lower Sacramento River and Delta during the late fall and winter (NOAA Fisheries 2004a).

The outmigration period is from December through March (although some reports from April: see below). It is believed that their transit through the Bay to the Ocean is similar to that of fall Chinook salmon (not federally listed) that take about 40 days to travel through the Bay. Fall Chinook salmon show no significant growth during their transit through the Bay (MacFarlane and Norton 2002; NOAA Fisheries, pers. comm.).

***Critical Habitat for Sacramento River winter-run Chinook (SRW) salmon:*** Part of the designated critical habitat for SRW Chinook salmon includes all waters of San Francisco Bay (north of the San Francisco/Oakland Bay Bridge) from San Pablo Bay to the Golden Gate Bridge (Federal Register 1993). This critical habitat designation includes the river water, river bottom, and the adjacent riparian zone. In areas westward from Chipps Island, including San Francisco Bay to the Golden Gate Bridge, it includes the estuarine water column, essential foraging habitat, and food resources used by the SRW Chinook salmon as part of their juvenile out-migration or adult spawning migration.

The only area of potential work that may occur within designated critical habitat is Brooks Island, located about six miles northeast of the San Francisco/Oakland Bay Bridge. Hayward Regional Shorelines and Don Edwards NWR are outside of the designated critical habitat area, being located south of the bridge.

At Brooks Island which was created by dredge spoils, a stone revetment or geotube filled with dredged material may be considered for future shoreline protection. The worst-case scenario would involve inter-tidal fill along the shoreline of Brooks Island along the Richmond Channel. The Corps of Engineers will reinitiate consultation on this issue if this project is pursued in the future.

***Central California Coast (CCC) Coho Salmon:*** Brown et al. (1994) reviewed historical population estimates in California and found coho numbers to be between 200,000 and 500,000 in the 1940's, 100,000 in the 1960's, and 30,480 between 1984 and 1985. From 1987 to 1994 an average of 31,000 adult coho (about 4,000 wild stock, 9,000 natural stock, and 18,000 hatchery stock) were estimated to have entered California streams each year to spawn. Population numbers of the CCC coho salmon ESU are not well known, but are low. The California Department of Fish and Game introduced coho salmon into the Sacramento River in 1956 but populations waned by 1963 (Bettelheim 2002).

Several hatcheries are located along the central California coast. About 350,000 coho salmon were released annually between 1987 and 1991. The largest production facilities release about 100,000 coho salmon each year. There has been considerable movement of coho salmon between hatcheries or egg-taking stations in central and northern California, with fish eventually outplanted in either area. These transfers primarily involved California hatchery stocks and may have also included Oregon and Washington stocks that were not identified as such (Weitkamp et al. 1995). No hatcheries production comes from tributaries to San Francisco Bay.

The CCC coho salmon occurs principally south of San Francisco Bay but occurrence in San Francisco Bay is possible (NOAA Fisheries 2004, pers. comm.). Critical habitat includes tributaries to San Francisco Bay. This includes tributaries of the north Bay and south Bay but not the Bay itself. Juveniles emigrate to salt water as yearlings. A year after their emergence, in March and April, yearlings begin their downstream migration (Shapovalov and Taft 1954). Juveniles would be expected to occur in San Francisco Bay in the spring, if spawning occurs in tributaries to San Francisco Bay.

***Central California Coast (CCC) Steelhead:*** Two estimates of historic (pre-1960s) abundance specific to this ESU are available: An average of about 500 adults in Waddell Creek in the 1930s and early 1940s, and 20,000 steelhead in the San Lorenzo River before 1965. In the mid-1960s, 94,000 adult steelhead were estimated to spawn in the rivers of this ESU, including 50,000 fish in the Russian River and 19,000 fish in the San Lorenzo River. Recent estimates indicate an abundance of about 7,000 fish in the Russian River (including hatchery-produced steelhead) and about 500 fish in the San Lorenzo River. These estimates suggest that recent total abundance of steelhead in these two rivers is less than 15 percent of their abundance in the mid 1960s. Recent estimates for several other streams (Lagunitas Creek, Waddell Creek, Scott Creek, San Vincente Creek, Soquel Creek, and Aptos Creek) indicate individual run sizes of 500 fish or less.

CCC Steelhead in most tributaries to San Francisco and San Pablo bays have been virtually extirpated. Fair to good runs of steelhead occur in coastal Marin County tributaries. In a 1994 to 1997 survey of 30 San Francisco Bay watersheds, steelhead occurred in small numbers at 41 percent of the sites, including the Guadalupe River, San Lorenzo Creek, and Corte Madera Creek. Presence/absence data available since the proposed listing show that in a subset of streams sampled in the central California coast region, most contain steelhead (NOAA Fisheries 2004a).

The West Coast Salmon Biological Review Team concluded that the CCC steelhead ESU is presently in danger of extinction including the portion within San Francisco Bay. Currently there is a lack of information on run sizes throughout the ESU (NOAA Fisheries 1996).

The Warm Springs Hatchery on the Russian River is currently the only major steelhead facility within the range of this ESU (Busby et al. 1996). The Russian River enters the Ocean north of San Francisco Bay.

CCC steelhead spawn in streams from the Russian River to Aptos Creek, Santa Cruz County and the drainages of San Francisco and San Pablo Bays eastward to the Napa River, Napa County. This run does not occupy the Sacramento-San Joaquin River Basin of the Central Valley of California (Federal Register 1997).

In general, juvenile steelhead live in freshwater from one to four years before becoming smolts and migrating to saltwater. Most steelhead smolts outmigrate in March and April (Barnhart 1986). Length of stay in San Francisco Bay is not well known. Since some CV steelhead may rear entirely in the Bay before returning to spawn in natal streams and not enter the Ocean at all, it is possible that CCC steelhead do the same.

***Environmental Baseline***

The factors presenting risks to the five listed salmonid ESUs in California are numerous and varied. A number of documents have addressed the history of human activities, present environmental conditions, and factors contributing to the decline of salmon and steelhead species listed under the ESA. Profound alterations to the estuarine environment of San Francisco Bay began with the discovery of gold in the middle of the 19$^{th}$ century. Dam construction, water diversion, hydraulic mining, and the diking and filling of tidal marshes soon followed, launching San Francisco Bay into the era of rapid urban development and coincident habitat degradation.

***Habitat:*** Land use activities since the 1850s associated with urban development and industrial development have altered fish habitat quantity and quality. In the past 150 years, urbanization has resulted in the diking and filling of tidal marshes. Industrial development has resulted in the construction of large docks and piers. These changes have reduced the acreage of wetlands and increased pollutant loadings to the San Francisco Bay estuary (NOAA Fisheries 2003b). Installation of docks, shipping wharves, marinas, and miles of rock rip rap for shoreline protection have contributed greatly to the loss and degradation of shoreline and wetland habitat within the action area (NOAA Fisheries 2003b). These impacts have diminished the amount of suitable foraging habitat and cover for juvenile salmonids along shoreline and wetland areas.

Industrial, municipal, and agricultural wastes have been discharged into the waters of San Francisco Bay, with major historical point sources including wastes from fish, fruit, and vegetable canneries and municipal sewage. The large-scale pollution of San Francisco Bay estuary was partially relieved by the passage of the Clean Water Act in 1972, resulting in the construction of sewage treatment plants in all cities. Non-point sources of pollution, such as urban and agricultural runoff, continue to degrade water quality today. These contaminants may impair physiological development of juvenile salmonids that could reduce survival potential during the oceanic phase (NOAA Fisheries 2003b).

As native fish stocks became depleted in the late 19th century, non-native species were brought into the bay and delta, including American shad, striped bass, common carp, and white catfish. As their populations boomed, those of native fishes declined further. Introduction of non-native species accelerated in the 20th century through deliberate introductions of fish and unintended introductions of invertebrates through ballast water of ships. Establishment of non-native species was probably facilitated by altered hydrologic regimes and reduction in habitats for native species. The introduction and spread of non-native species in the San Francisco Bay estuary has affected native species, including listed salmonids, through competition for food and habitat, and predation on native species (NOAA Fisheries 2003b).

***Hatcheries:*** Hatchery production of Chinook salmon and steelhead salmon occurs in several Central Valley hatcheries. A significant portion of Central Valley hatchery production is transported downstream for release. Competition may occur between hatchery and native salmonid juveniles in the estuary and may lead to decreased survival and production of listed salmonids. Outplanting of hatchery-reared salmon in San Francisco Bay, San Pablo, and Carquinez Strait contributes to elevated straying levels for returning adult spawners. Straying by hatchery-origin fish poses a variety of ecological and genetic hazards to natural populations.

Additional impacts associated with releasing large numbers of hatchery fish include competition for food and other resources, predation by hatchery fish on wild fish, and increased fishing pressure on wild stocks as a result of hatchery production (NOAA Fisheries 2003b).

***Harvest:*** Ocean salmon fisheries off California, Oregon, and Washington are managed to meet the increasingly complex combination of NOAA Fisheries' requirements established through

ESA section 7 consultations and the spawning escapement goals established for certain key stocks under the FMP. NOAA Fisheries issued biological opinions in 1996 and 1997 that required reductions in ocean harvest impacts on Sacramento River winter chinook. Opinions issued in 1998 and 1999 limited the ocean exploitation rate on Oregon coastal coho and southern Oregon/northern California coho and prohibited retention of coho salmon in ocean fisheries off California.

The Chinook salmon fisheries off California, which target Sacramento River fall run chinook, have in recent years been constrained to meet FMP escapement goals and in-river harvest allocation objectives for Klamath River fall chinook, as well as NOAA Fisheries' ESA consultation standards for listed Sacramento River winter chinook and three listed ESUs of coho. The FMP spawning escapement objective is between 33 percent and 34 percent of the potential adult natural spawners, but no fewer than 35,000 naturally spawning adults in any one year. In 1993, the Department of the Interior quantified the federally reserved fishing rights of the Yurok and Hoopa Valley Indian tribes of the Klamath Basin. The Tribes are entitled to 50 percent of the total available harvest of Klamath-Trinity Basin salmon. Application of Tribal fishing rights has required significant reductions in the ocean harvest rate on Klamath River fall chinook and will permanently constrain California and Oregon commercial troll seasons relative to pre-1993 seasons.

Commercial and sport fisheries in areas north of Point Arena, where Klamath River fall chinook make up a significant portion of the catch, are capable of taking the entire ocean allocation of Klamath River fall chinook in relatively short periods of time. Fishing seasons have been severely restricted in these areas to allow longer seasons south of Point Arena and permit access to the relatively abundant stocks of Central Valley fall chinook. The annual abundance of Central Valley Chinook salmon is estimated by the Central Valley Index (CVI), which is the sum of the ocean chinook harvest south of Point Arena and the Central Valley adult chinook spawning escapement of the same year. The harvest of Central Valley chinook is evaluated by the Central Valley Ocean Harvest Index, which is calculated as the total catch of chinook south of Point Arena divided by the CVI. The Ocean Harvest Index is an indicator of the annual harvest rate (catch/(catch+escapement)) of Central Valley chinook. Commercial harvest rates, as indicated by the commercial component of the Ocean Harvest Index have been declining since the late 1980s. From 1986 to 1993 the commercial harvest averaged 56 percent of the CVI abundance index, compared to an average of 44 percent from 1994 to 1999. Recreational harvests averaged 17 percent of the CVI between 1986 and 1992 and 20 percent of the CVI between 1993 and 1999. Several factors bias the Central Valley Ocean Harvest Index as an indicator of harvest rate of Central Valley fall run chinook. The catch of Chinook salmon south of Point Arena (including stocks originating from outside the Central Valley) may not equal the total ocean catch of Central Valley chinook. Estimates of the magnitude of the recreational catch in the Central Valley have not consistently been available and are not included in the estimate of chinook escapement to the Central Valley. It is not clear how these factors bias the Index with respect to actual harvest rates of Central Valley chinook.

Sport harvest of steelhead in the ocean is prohibited by the California Department of Fish and Game, and ocean harvest is rare (BRT 2003). Freshwater sport fishing probably constitutes a larger impact. All coastal streams are closed to fishing year round except for special listed streams which allow catch-and-release angling or summer trout fishing. Catch-and-release angling with restricted timing (generally, winter season Sundays, Saturdays, Wednesdays, and holidays) is allowed in the lower mainstems of many coastal streams south of San Francisco.

The Russian River is the largest system and probably originally supported the largest steelhead population in the CCC steelhead ESU. The mainstem is currently open all year and has a bag limit of two hatchery steelhead or trout, but above the confluence with the East Branch, it is closed year round. Santa Rosa Creek and Laguna Santa Rosa, Sonoma County tributaries to the Russian River, have a summer catch-and-release fishery. Tributaries to the San Francisco Bay system have less restricted fisheries. All streams in Alameda, Contra Costa, and Santa Clara Counties (east and south Bay) have summer fisheries with a bag limit of five, except for special cases that are closed all year round. For catch-and-release streams, all wild steelhead must be released unharmed. Mortality is estimated to be about 0.25 to 1.4 percent, based on angler capture rates measured in other river systems throughout California (range: 5 to 28 percent) , multiplied by an estimated mortality rate of 5 percent once a fish is hooked. This estimate may be biased downward because it doesn't account for multiple catch/release events.

Summer trout fishing is allowed in some lakes and reservoirs or in tributaries to lakes, generally with 2 or 5 bag limit.

Retention of coho salmon by commercial troll fishers south of Cape Falcon, Oregon, has been prohibited since 1993 (BRT 2003). From Cape Falcon, OR, south to Horse Mountain, CA, retention of coho salmon in recreational ocean fisheries has been prohibited since 1994, and in 1995 this prohibition was extended to include all California ocean recreational fisheries (BRT 2003). The conservation objective set by the Pacific Fishery Management Council has been an overall ocean exploitation of ≤ 13 percent for CCC coho salmon as indicated by Rogue/Klamath hatchery stocks (BRT 2003). Post-season estimates of Rogue/Klamath exploitation rate are unavailable; however, projected exploitation rates ranged from 3.0 to 11.7 percent during the period 1998 to 2002, and inside harvest estimates of coho salmon are not available for rivers in the CCC ESU (BRT 2003).

***Natural Conditions:*** San Francisco Bay estuary provides migratory and rearing habitat for three Chinook salmon ESUs and two steelhead ESUs. Historically, portions of the estuary have also provided habitat for coho salmon. Factors for decline at the time of listing include urban development, flood control, water development, and other anthropogenic factors. The estuary is an intensively urbanized center for industry, agriculture, and commerce.

Activities associated with road construction, urban and industrial development, flood control, and recreation have adversely affected the quantity and quality of salmonid spawning, rearing, and migratory habitats. Urbanization has resulted in severe and permanent impacts due to stream channelization, increased bank erosion, riparian damage, and pollution (NMFS 1996). Many streams have dams and reservoirs that mute flushing stream flows, withhold or reduce water levels suitable for fish passage and rearing, physically block upstream fish passage, and retain valuable sediments for spawning and rearing. Impaired stream reaches are vulnerable to further perturbation resulting from poor land use management decisions.

The pervasive negative effects of urbanization on watershed and riparian corridor functions have been documented by numerous researchers. Steiner Environmental Consulting (1996) cited Botkin *et al.* (1995) who determined that urbanization had degraded salmon habitat through stream channelization, flood plain drainage, and damage to riparian vegetation. Stream pollution is likely to increase with higher human density, degrading water quality for both people and wildlife (Florsheim and Goodwin 1993). The effects of urbanization are associated with lower fish species diversity and abundance (Weaver and Garman 1994).

***Conclusion:*** Significant steps towards the largest ecological restoration project yet undertaken in the United States have occurred during the past ten years in California's Central Valley. The CALFED Program and the Central Valley Project Improvement Act's (CVPIA) Anadromous Fish Restoration Program (AFRP), in coordination with other Central Valley and Bay Area efforts, have implemented habitat restoration actions including wetland restoration projects in the action area. Restoration of wetland areas typically involves flooding lands previously used for agriculture, thereby creating additional wetland areas and rearing habitat for juvenile salmonids, other fish species, and birds. Additional restoration efforts are ongoing or proposed for several watersheds in the estuary. Salmonid populations, however, remain depressed, and habitat in the action area has been decreased and degraded. The most recent status review update concludes that these ESUs remain at risk of extinction.

**Effects of the Action**

Nesting ecology and diet of Caspian terns have been studied in detail in San Francisco Bay (Roby et al. 2003 and 2004; Strong et al. 2003). Caspian terns arrive at San Francisco Bay about mid-March. In 2004, the first Caspian terns observed near the Brooks Island colony occurred on March 7 and the first terns observed on the colony occurred on March 19. Caspian terns are strictly piscivorous. In San Francisco Bay, Caspian terns feed exclusively on fish that are 5 to 25 cm in length (see above in Caspian Tern Biology section). All listed runs of salmonids entering San Francisco Bay as juveniles will be, for the most part, of adequate size to be taken as prey by Caspian terns. Chinook salmon juveniles typically enter the Bay at lengths of at least 8 cm and steelhead, after more extensive rearing in freshwater, enter at about 15 to 20 cm. Occasionally during wet years with high flow, non-listed fall-run Chinook fry are noted in the Bay at lengths of about 4 cm (California Dept. Fish and Game 2004a, pers. comm.).

Terns from colonies at Hayward Regional Shoreline and Don Edwards National Wildlife Refuge (NWR) are not expected to impact emigrating juveniles because salmonids consumed by terns from existing colonies (Baumberg Pond and Pond A-7) near these two locations consisted entirely of rainbow trout from local reservoirs with the exception of one juvenile Chinook (Roby et al. 2004). Additionally, these colonies are located about 25 and 30 miles (south), respectively from the opening of the Bay. Caspian tern studies in the lower Columbia River documented that 90 percent of terns foraged within about 13 miles of the colony site (Collis et al. 1998). Juveniles from listed ESUs are believed to go directly through the north part of the Bay and into the ocean (B. MacFarlane, NOAA Fisheries 2004, pers. comm.) and other forage fish species are plentiful in the south Bay. Thus, we do not expect terns from these two south bay sites to consume juvenile salmonids.

The Caspian tern colony on Brooks Island has been the largest one in San Francisco Bay since 1997, supporting 2,080 birds (1,040 pairs) in 2004 (Roby et al. 2004). Terns nesting on Brooks Island would have easy access to emigrating juveniles as this colony is located just northeast of the opening of the Bay and because the Bay is somewhat constricted in width between Point Richmond and the Tiburon Peninsula (i.e., fish would be funneled through a section of the Bay that is only about three miles wide in the vicinity of Brooks Island). Caspian tern diet composition studied at Brooks Island in 2003 and 2004 by observation of bill loads showed that 1.9 to 3.3 percent of fish identified in the diet during the breeding season were salmon, although not be identified to ESU (Roby et al. 2003 and 2004). Thus, we expect juvenile salmonids to be consumed by terns nesting at Brooks Island.

For this effects analysis, we used the upper end of the data (3.3 percent) on tern diet composition from Brooks Island collected in 2003 and 2004 to calculate a maximum potential take from terns on Brooks Island. Because consumption of juvenile salmonids is not expected to occur by terns in the South Bay, no attempt will be made to estimate take by potential Caspian tern colonies at Hayward Regional Shorelines and Don Edwards NWR.

***CVS and SRW Chinook Salmon:*** Juvenile CVS Chinook salmon will be vulnerable to tern predation during their approximate 40-day migration through San Francisco Bay before they reach the Pacific Ocean. The outmigration period is from March through April and into May (and some reports from June). Juvenile SRW Chinook salmon will be vulnerable to tern predation during their migration through San Francisco Bay before they reach the Pacific Ocean. The latter part of their outmigration in March and April will overlap with Caspian tern occurrence in the Bay.

Juvenile CVS Chinook salmon are typically about 80 mm in length upon entering the Pacific Ocean at the Farallon Islands (Fisher 1994). SRW juvenile Chinook salmon are typically about 120 mm in length upon entering the Pacific Ocean at the Farallon Islands (Fisher 1994). Since juveniles likely do not show significant growth during their transit through the North Bay, juveniles would be of appropriate size for Caspian tern predation.

Trawl samples from Chipps Island near the mouth of the Sacramento River provides Catch Per Unit Effort data for various ESUs coming into San Francisco Bay from the Sacramento and San Joaquin Basins (California Department of Fish and Game, Central Valley Bay-Delta Branch. Internet site). Sampling in 2004 began on April 5 and continued through June 30 (Caspian terns are present in San Francisco Bay during this entire sampling period). All juvenile salmonids caught are accounted for in the data except marked hatchery fish (the great majority of hatchery fish however are unmarked and included in counts). Of the ESUs considered in this BA, data are available for CVS Chinook salmon and SRW Chinook salmon.

Year 2004 trawl data from Chipps Island, near the mouth of the Sacramento River, show spring-run juveniles entering the Bay from April 5 through June 9 (although no sampling was conducted before April 5) with peak abundance in late April (California Dept. Fish and Game Internet Site).

Year 2004 trawl data from Chipps Island, near the mouth of the Sacramento River, show SRW Chinook juveniles entering the Bay on April 5, April 7, and April 21 (although no sampling was conducted before April 5, California Dept. Fish and Game Internet Site). These data are presented as catch per unit effort. As terns arrive in mid-March, emigrating juveniles would be susceptible to predation throughout most if not all of their transit through the Bay.

All steelhead captured at Chipps Island are assumed to be CV steelhead (California Dept. Fish and Game 2003, pers. comm.). However, steelhead are not often captured because they are generally large enough to avoid the trawl nets. Data are also available for non-listed fall-run Chinook salmon and non-listed late fall-run Chinook salmon. Identification of runs is based on size and timing and is not entirely accurate (U.S. Fish and Wildlife Service 2004, pers. comm.).

Assuming equal catchability from trawling, relative abundances of Chinook salmon (wild and un-marked hatchery combined) entering San Francisco Bay can be determined by summing the Catch per Unit Effort (which is recorded on a daily basis as fish per cubic meter of water sampled) over the entire sampling period for each run and considering that number as a proportion of the summed Catch per Unit Effort of all runs (Table 1).

**Table 1. Summed Catch per Unit Effort and relative abundance (percent) of juvenile Chinook salmon from trawl efforts at Chipps Island, San Francisco Bay, April 5 through June 30, 2004.**

| Salmon Run | Σ CPUE | Relative Abundance |
|---|---|---|
| Chinook (spring-run) | 19.4265 | 6.20 |
| Chinook (fall-run, not listed) | 293.5923 | 93.72 |
| Chinook (winter run) | 0.2152 | 0.07 |

Relative abundance numbers, however, are not necessarily proportional to population numbers of juveniles over entire periods of emigration because emigration also occurs before the earliest date of sampling at Chipps Island.

In 2004, food habits studies of Caspian terns at Brooks Island showed that they preyed on a variety of fishes. Anchovy was the most commonly taken fish, constituting 24.4 percent of observed catches. Salmon constituted 3.3 percent of fish taken. No salmon were noted in the 2004 diet until May 16 (Roby et al. 2004). Roby et al. (2004) concluded that the Caspian tern salmon diet at Brooks Island consisted primarily of juvenile Central Valley fall-run Chinook salmon and that the higher proportion of juvenile salmon in the diet in 2004 compared to 2003 might have been accounted for by a decline in availability of some marine forage fishes. California Dept. In support of this theory, Calif. Dept. of Fish and Game reported fewer northern anchovies in trawls operated in 2004 than in 2003 throughout the San Francisco Bay Basin.

Fall-run Chinook salmon and spring-run Chinook salmon show greatest abundance at Chipps Island in late April and early May, and therefore would be expected to be in the vicinity of

Brooks Island later in May and perhaps early June, as these runs are believed to take about 40 days to travel through the Bay to the Ocean. Salmon constituted 18.5 percent of the Caspian tern fish catches on June 6, 9.3 percent on June 13, and 10 percent on June 20.

***Potential Take Estimate:*** Assuming that the sizes of prey items in San Francisco Bay is comparable to East Sand Island and the percentage of juvenile salmonids in the diet of terns nesting in San Francisco Bay remains comparable to that observed in 2003 and 2004, we can estimate potential take of Central Valley spring-run Chinook by nesting terns (see Table A.4). If terns take about 1,000 fish per nesting season (Table A.1) and 3.3 percent of these are juvenile salmon at Brooks Island, then about 33 juvenile salmon would be expected to be taken per nesting season per adult Caspian tern. At the full projected colony size of 1,500 nesting pairs (3,000 birds), approximately 99,000 juvenile salmon are projected to be taken by all adult Caspian terns per nesting season at Brooks Island. Of these 99,000, a total of 30,360 would be taken by the 460 pairs (920 birds) that would be added to the existing colony given implementation of the proposed action. Using data from Chipps Island and assuming equal catchability of all runs by Caspian terns, numbers can be projected for individual runs (Table 2).

**Table 2. Potential take per year of juvenile salmon by an additional 460 pairs of Caspian terns at Brooks Island.**

| Salmon Run | Abundance | Relative Abundance | Projected Take |
|---|---|---|---|
| Chinook (spring-run) | 2,000,000 | 2.11 | 641 |
| Chinook (winter run) | 100,000 | 0.11 | 33 |
| Chinook (fall-run, not listed) | 60,000,000 | 63.36 | 19,255 |
| All hatchery salmonids | 32,600,000 | 34.42 | 10,460 |
| Total | 94,700,000 | 100 | ~ 30,390 |

To determine the projected take of each salmon run (see Table 2), their relative abundance (estimated number of juvenile salmon per run divided by estimated total juvenile salmon) was multiplied by the total projected take to generate projected take by salmon run (e.g. 30,390 x 0.0211 = 641 spring run Chinook).

Of the approximately 30,400 salmonids projected to be taken by the additional 460 pairs of Caspian terns at Brooks Island, about 640 spring-run Chinook salmon and 33 winter-run Chinook salmon are projected to be taken per year. Impacts to juvenile salmon from tern predation could vary significantly from year to year, however, depending on such factors as numbers of spawners returning, spawning conditions, fluxes in abundance of other forage fishes taken by terns, tern abundance, and changes in hatchery practices. Roby et al. (2004) stated that the unlisted Central Valley fall-run Chinook represented most, if not all, of the salmonids consumed by terns in San Francisco Bay in 2004. This conclusion was based on: (1) the dates when juvenile salmonids were identified in Caspian tern bill-loads; (2) the proximity of tern colonies to the mouth of the Sacramento River; and (3) the length of juvenile salmonid bill-loads (estimated during bill load identifications from observation blinds, Roby et al. 2004).

Among wild Chinook salmon, only fall-run fish continue to maintain reasonable, although low, spawning runs (Fisher 1994), and are heavily supported by hatchery production (MacFarlane and Norton 2001). Wild steelhead and coho runs are very depleted.

***CV Steelhead, CCC Coho Salmon, and CCC Steelhead:*** Juvenile CV and CCC steelhead will be vulnerable to Caspian tern predation during their migration through San Francisco Bay before they reach the Pacific Ocean or, if they remain in the Bay, up to the time they exceed the maximum length that a Caspian tern could prey upon. CCC coho salmon populations in the San Francisco Bay area are unknown and very limited instream distribution, and thus, it is unclear how vulnerable this ESU would be to tern predation. The outmigration period for CV steelhead is from December through June and fish rear extensively in the Bay (Calif. Dept. Fish and Game, pers. comm.). The outmigration period for CCC steelhead is likely greatest in March and April. Caspian terns typically arrive at San Francisco Bay in March (Roby et al. 2004) and therefore would overlap with the outmigration period for these ESUs.

Year 2004 trawl data from Chipps Island, near the mouth of the Sacramento River, show juvenile CV steelhead entering the Bay from April 9 through June 21 (although no sampling was conducted before April 5) with peak abundance in early April (California Dept. Fish and Game Internet Site). These data are presented as catch per unit effort and very few CV steelhead are caught. Most steelhead emigrating past Chipps Island are able to avoid capture in the trawl nets because of their large size (NOAA Fisheries 2004, pers. comm.). No trawl data are available for CCC coho or steelhead.

CV steelhead, after rearing in freshwater, enter the Bay at about 15 to 20 cm, and therefore are of appropriate size to be preyed upon by Caspian terns. Based upon an annual hatchery release estimate of 2.8 million and wild production of 300,000 juvenile steelhead, approximately 3.1 million juvenile steelhead could ostensibly be vulnerable to Caspian tern predation in San Francisco Bay. Outmigrating CCC steelhead from Waddell Creek show lengths from 14 to 21 cm (5.5 to 8.3 inches). Juveniles while in the Bay would be of appropriate size to be preyed upon by Caspian terns. Wild CCC steelhead population numbers in the San Francisco Bay area are unknown and very limited in stream distribution.

Roby et al. (2004) reported that juvenile salmonids comprised 3.3 percent of the terns' diet at Brooks Island in 2004. They further reported that these juvenile salmonids were primarily fall Chinook salmon. No steelhead were reported in the diet of terns at the Brooks Island colony, however field observations comprised only a small sample of the total fish delivered on colony. Although steelhead and coho were not observed in the diet of Caspian terns at Brooks Island by Roby et al. (2004), it is reasonable to presume that CV steelhead, and probably to a lesser extent, CCC steelhead and coho collectively comprise a minor portion of the diet of Caspian terns at Brooks Island.

***Potential Take Estimate:*** An accurate take estimate for these species is difficult to obtain because sufficient data from Caspian terns nesting in San Francisco Bay has not been collected to produce this estimate. A gross estimate can be generated using data from the East Sand Island Caspian tern colony (2000 to 2004) in combination with data obtained from Brooks Island in Roby et al. (2004). This estimate assumes that size of prey items in San Francisco Bay is comparable to the Columbia River estuary and the percentage of juvenile salmonids in the diet of terns nesting in San Francisco Bay remains comparable to that observed in 2003 and 2004. Caspian terns on East Sand Island were estimated to consume approximately 1,000 total fish per bird (range 837 to 1084 fish) across species during the breeding season (Table A.1). This average number of fish consumed (and range) was then used to assess salmonid consumption at San Francisco Bay.

If terns take an average of 1,000 (837 to 1084) fish per nesting season and 3.3 percent of these are juvenile salmon at Brooks Island, then about 33 (28 to 36) juvenile salmon would be expected to be taken per nesting season per adult Caspian tern. At the full projected colony size of 1,500 nesting pairs (3,000 birds), approximately 99,000 (84,000 to 108,000) juvenile salmon are projected to be taken by all adult Caspian terns per nesting season at Brooks Island. Of these 99,000, a total of 30,360 (25,760 to 33,120) would be taken by the 460 pairs (920 birds) that would be added to the existing colony given implementation of the proposed action. As described above, Roby et al. (2004) concluded that the Caspian tern salmon diet at Brooks Island consisted primarily of juvenile Central Valley fall-run Chinook salmon and that the higher proportion of juvenile salmon in the diet in 2004 compared to 2003 might have been accounted for by a decline in availability of some marine forage fishes.

We expect CV steelhead, and probably to a lesser extent, CCC steelhead and coho, to collectively comprise a minor portion of the diet of Caspian terns at Brooks Island. For this analysis, we are assuming that these species comprise from 1-5 percent of the salmonid composition (30,360) of the diet of the additional 460 Caspian terns at Brooks Island. Thus, we estimate that, collectively, 304 to 1,518 juveniles of these species could be taken by the additional Caspian terns that occur at Brooks Island attributable to the proposed action. Based on their numbers and thus, availability, in the bay, we further assume that majority (80 percent) of this proportion (304 to 1,518 juvenile salmonids) would be from the CV steelhead ESU. CCC steelhead and coho would then, equally comprise the remaining 20 percent (see Table A.4).

**Effects Determination**

Implementation of the proposed action in San Francisco Bay will adversely affect CV steelhead, CVS Chinook salmon, SRW Chinook salmon, CCC coho salmon, and CCC steelhead. The projected take for: CVS Chinook salmon is 641 juveniles; SRW Chinook is 33 juveniles; CV steelhead is estimated to be 243 to 1,214 juveniles; CCC coho salmon is estimated to be 30 to 151 juveniles; and CCC steelhead is estimated to be 30 to 151 juveniles.

## Literature Cited and Other References

Aceituno, M. E., M. L. Caywood, S. J. Nicola, and W. I. Follett. 1976. Occurrence of Native Fishes in Alameda and Coyote Creeks, California. California Fish and Game 62(3):195-206.

Anderson, S. K., D. D. Roby, D. E. Lyons, and K. Collis. *In Review*. Effects of food availability on foraging patterns, diet, and nesting success of Caspian terns in the Columbia River estuary.

Anderson, S.K. 2003. Foraging ecology, colony attendance, and chick provisioning of Caspian terns (Sterna caspia) in the Columbia River estuary. M.S. thesis, Oregon State University, Corvallis OR. 101 pp.

Atwood, J.L. and P.R. Kelly. 1984. Fish dropped on breeding colonies as indicators of least tern food habits. Wilson Bulletin. 96:34-47.

Barnhart, R.A. 1986. Species profiles: Life histories and environmental requirements of coastal fishes and invertebrates (Pacific Southwest) – steelhead. U.S. Fish and Wildlife Service Biological Report 82(11.60). U.S. Army Corps of Engineers, TR EL-82-4. 21 pp.

Bettelheim, M. (California Department of Fish and Game). 2002 (January). A Review of the History, Natural History, and Status of Coho Salmon (*Oncorhynchus kisutch*) in California: A Literature Review.

Botkin, D. B., K. Cummins, T. Dunne, H. Regier, M. Sobel, L. Talbot, and L. Simpson. 1995. Status and future of salmon of western Oregon and northern California: Overview of findings and options. The Center for the Study of the Environment. Santa Barbara, CA. [as cited in Steiner Environmental Consulting 1996].

Brown, L.R., P.B. Moyle, and R.M. Yoshiyama. 1994. Historical discline and current status of coho salmon in California. North American Journal of Fisheries Management. Vol. 14. No. 2.

BRT (Biological Review Team). 2003. Draft report of updated status of listed ESUs of salmon and steelhead. National Marine Fisheries Service. Seattle, WA. Available at: http://www.nwfsc.noaa.gov/trt/brtrpt.htm

Busby, P.J. T.C. Wainright, G.J. Bryant, L.J. Lierheimer, R.S. Waples, F.W. Waknitz, and I.V. Lagomarsino. 1996 (August). Status Review of West Coast Steelhead from Washington, Idaho, Oregon, and California. NOAA Tech Memo NMFS-NWFSC-27.

California Department of Fish and Game. 2004a. Personal communications.

California Department of Fish and Game. 2004b (June). Sacramento River Winter-run Chinook Salmon. Biennial Report (2002-2003). Prepared by the Habitat Conservation Division Native Anadromous Fish and Watershed Branch.

California Department of Fish and Game. Internet site. Showing catch per unit effort at Chipps Island. http://165.235.108.8/data/rtm2004

California Department of Fish and Game. Landings data. Available at: www.dfg.ca.gov/mrd/landings02.html

Clark, F.H. 1929. Sacramento-San Joaquin salmon, Oncorhynchus tshawytscha, fishery of California. California Fish and Game Bulletin. 17:73.

Clemens, W. A. and G. V. Wilby. 1961. Fishes of the Pacific Coast of Canada. Fisheries Research Board of Canada. Bulletin No. 68.

Coleman National Fish Hatchery. 2004. Personal communications.

Collis, K., D. D. Roby, D. P. Craig, B. A. Ryan, and R. D. Ledgerwood. 2001. Colonial Waterbird Predation on Juvenile Salmonids Tagged with Passive Integrated Transponders in the Columbia River Estuary: Vulnerability of Different Salmonid Species, Stocks, and Rearing Types. Transactions of the American Fisheries Society. 130:385-396.

Cuthbert, F.J., and L. Wires. 1999. Caspian Tern (*Sterna caspia*). *In* The birds of North America, No. 403 (A. Poole and F. Gill, eds). The Birds of North America, Inc., Philadephia, PA.

East Bay Regional Parks. 2004. Personal communications.

Federal Register. 1993 (June 16). 58 FR 33212. Final Rule: Designated Critical Habitat; Sacramento River Winter-run Chinook Salmon.

Federal Register. 1997 (August 18). 50 CFR Parts 222-227. Endangered and Threatened Species: Listing of Several Evolutionary Significant Units (ESUs) of West Coast Steelhead.

Federal Register. 1997 (December 19). 50 CFR Part 600. Magnuson-Stevens Act Provisions; Essential Fish Habitat.

Fisher, F.W. 1994. Past and Present Status of Central Valley Chinook Salmon. Conservation Biology. 8(3):870-873.

Fisher, T. and R. Hinrichsen. 2004. Preliminary abundance-based trend results for Columbia basin salmon and steelhead ESUs. Report for J. Geiselman, Bonneville Power Administration, Portland, OR. November.

Feather River Hatchery. 2004. Personal communications.

Florsheim, J.L. and P. Goodwin. 1993. Geomorphic and hydrologic conditions in the Russian River, California: historic trends and existing conditions. Prepared for the California State

Coastal Conservancy and the Mendocino County Water Agency. [as cited in Steiner Environmental Consulting 1996].

FMEP (Fisheries Management and Evaluation Plan). Available at: http://www.nwr.noaa.gov/1fmep/fmepinpl.htm

Hunt, S. L., T. J. Mulligan, and K. Komori. 1999. Oceanic feeding habits of Chinook salmon, *Oncorhynchus tshawytscha*, off northern California. Fisheries Bulletin. 97:717-721.

Johnson, R.R., F.W. Fisher, and D.D. Weigand. 1992. Use of growth data to determine the spatial and temporal distribution of four runs of juvenile Chinook salmon in the Sacramento River, California. Report N. AFF.-FRO-92-15. U.S. Fish and Wildlife Service, Red Bluff, California.

Harvey, T.E., K.J. Miller, R.L. Hothem, M.J. Rauzon, G.W. Page, and R.A. Keck. 1992. Status and trends report on the wildlife of the San Francisco Estuary. Prepared by the U.S. Fish and Wildlife Service, Sacramento, California, for the San Francisco Estuary Project, U.S. Environmental Protection Agency, San Francisco, California.

Leidy, R. A. 1997. Estuary Report June 1997. U.S. Environmental Protection Agency San Francisco Estuary Project.

Leidy, R. A., G. S. Becker, and B. N. Harvey. 2003. Historical distribution and current status of steelhead (Oncorhynchus mykiss), coho salmon (O. kisutch), and chinook salmon (O. tshawytscha) in streams of the San Francisco Estuary, California. U.S. Environmental Protection Agency, San Francisco, and Center for Ecosystem Management and Restoration, Oakland, CA.

Lyons, D.E. 2004. Foraging ecology of Caspian terns and double-crested cormorants in the Columbia River estuary. M.S. thesis, Oregon State University, Corvallis OR. 95 pp.

Marshall, D.B., M. G. Hunter, and A.L. Contreras (eds.) 2003. Birds of Oregon: A General Reference. Oregon State University Press, Corvallis, Oregon. 752 pp.

MacFarlane, R.B. and E.C. Norton. 2002. Physiological ecology of juvenile Chinook salmon (*Oncorhynchus tshawytscha*) at the southern end of their distribution, the San Francisco Estuary and Gulf of the Farallones, California. Fisheries Bulletin. 100:244-257.

McEwan, D. and T.A. Jackson. 1996. Steelhead Restoration and Management Plan for California. California Department of Fish and Game. 234 pp.

Myers, J.M., R.G. Kope, G.J. Bryant, D. Teel, L.J. Lierheimer, T.C. Wainwright, W.S. Grand. F.W. Waknitz, K. Neely, S.T. Lindley, and R.S. Waples. 1998. Status review of Chinook salmon from Washington, Idaho, Oregon, and California. NOAA Tech. Memo. NMFS-NWFSC-35.

NMFS (National Marine Fisheries Service). 1996. Factors for decline; a supplement to the notice of determination for West Coast steelhead under the Endangered Species Act. Portland, OR. 80p.

NOAA Fisheries. Internet Site. Showing Central Valley Chinook salmon current stream habitat distribution table. http://swr.ucsd.edu/hcd/dist2.htm

__. 1996. Status Review of West Coast Steelhead. NOAA-NWFSC Tech Memo 27.

___ (National Marine Fisheries Service). 2000. Endangered Species Act Section 7 consultation. Biological Opinion on the impacts from the collection, rearing, and release of salmonids associated with artificial propagation programs in the Upper Willamette spring chinook and winter steelhead Evolutionarily Significant Units. Northwest Region. Portland, OR.

__. 2001. Endangered Species Act section 7 consultation and Magnuson-Stevens Act essential fish habitat consultation. Biological opinion on artificial propagation in the Hood Canal and eastern Strait of Juan de Fuca regions of Washington State. Hood Canal summer chum salmon hatchery programs by the U.S. Fish and Wildlife Service and the Washington Department of Fish and Wildlife and Federal and Non-Federal hatchery programs producing unlisted salmonid species. Sustainable Fisheries Division, Northwest Region, National Marine Fisheries Service. Portland, OR. 277 p.

__. 2003a. National Marine Fisheries Service Endangered Species Act section 7 consultation and Magnuson-Stevens Act essential fish habitat consultation number F/NWR/2003/00998. Prepared by the National Marine Fisheries Service, Northwest Region, Protected Resources Division, September 24, 2003.

__. 2003b. National Marine Fisheries Service Endangered Species Act section 7 consultation and Magnuson-Stevens Act essential fish habitat consultation number 151422SWR02SR6292. Benicia-Martinez new bridge project. Prepared by the National Marine Fisheries Service, Southwest Region. Southwest Region. Santa Rosa, CA. January 16, 2003.

__. 2004a. Artificial propagation evaluation workshop report. NOAA Fisheries, Northwest Region, Protected Resources Division. Seattle, WA. April 21-23, 2004. Available at: www.nwr.noaa.gov/1srd/Prop_Determins/

__. 2004b. National Marine Fisheries Service Endangered Species Act section 7 consultation and Magnuson-Stevens Act essential fish habitat consultation number F/NWR/2004/00727. Consultation on remand for operation of the Columbia River Power System and 19 Bureau of Reclamation projects in the Columbia basin. Prepared by the National Marine Fisheries Service, Northwest Region, Hydro Division, November 30, 2004.

__. 2004c. Joint state tribal resource management plan provided by the Washington Department of Fish and Wildlife and the Puget Sound Tribes for salmon fisheries affecting Puget Sound chinook salmon under limit 6 of the 4(d) rule - evaluation and determination. Sustainable Fisheries Division. Northwest Region. NOAA Fisheries. Seattle, WA.

__. 2004d. Puget Sound chinook salmon harvest plan - final environmental impact statement. Sustainable Fisheries Division. Northwest Region. NOAA Fisheries. Seattle, WA.

__. 2004e. Draft San Francisco Bay Fisheries Resource Section (Section 3.2.6: San Francisco and Monterey Bays, California).

PSIT/WDFW (Puget Sound Indian Tribes and Washington Department of Fish and Wildlife. 2004. Puget Sound comprehensive chinook management plan: harvest management component. February, 2004. 239 pages including appendices.

Realtime Research, Inc. 2002. Data.

Roby, D. D. K. Collis, S. K. Nelson, K. Larson, and K. Bixler. 2004 (September). Caspian Tern Nesting Ecology and Diet in San Francisco Bay and Dungeness NWR: Draft 2004 Annual Report.

San Francisco Chronicle. 2003 (December 30). Bald Eagles Make Home Near Lake Chabot, Rare for Them to Nest in Urban Bay Area.

San Francisco Estuary Project. 2000. State of the estuary 2000: Restoration primer. Oakland, CA.

Shapovalov, L. and A.C. Taft. 1954. The Life Histories of the Steelhead Rainbow Trout (*Salmo gairdneri gairdneri*) and Silver Salmon (*Oncorhynchus kisutch*) with Special Reference to Waddell Creek, California, and Recommendations Regarding Their Management. California Department of Fish and Game. Fish Bulletin No. 98.

Steiner Environmental Consulting. 1996. A history of the salmonid decline in the Russian River. Steiner Environmental Consulting, Potter Valley, CA.

Strong, C.M., L.B. Spear, T.P. Ryan, and R.E. Dakin. Forster's Tern, Caspian Tern, and California Gull Colonies in San Francisco Bay: Habitat Use, Numbers and Trends, 1982-2003. Report by San Francisco Bay Bird Observatory and H.T. Harvey and Associates. 38 pp.

U.S. Fish and Wildlife Service. 2003. Caspian Tern Nesting Ecology and Diet in San Francisco Bay and Interior Oregon.

__. 2004a (March 24). Endangered and Threatened Species that May Occur in or be Affected by Projects in the Area of the Alameda and Contra Costa Counties. Reference File No. 1-1-04-SP-1284.

__. 2004b. Caspian Tern Management to Reduce Predation of Juvenile Salmonids in the Columbia River Estuary. Draft Environmental Impact Statement.

__. 2004c. Personal communications.

WDFW and PNPTT (Washington Department of Fish and Wildlife and Point No Point Treaty Tribes). 2000. Summer chum salmon conservation initiative - Hood Canal and Strait of Juan de Fuca region. Washington Department of Fish and Wildlife. Olympia, WA. 424 p. plus appendices.

Weaver, L. A., and G. C. Garman. 1994. Urbanization of a watershed and historical changes in a stream fish assemblage. Trans. Am. Fish. Soc. 123:162-172.

Weitkamp, L.A., T.C. Wainwright, G.J. Bryant, G.B. Milner, D.J. Teel, R.G. Kope, and R.S. Waples. 1995 (September). Status Review of Coho Salmon from Washington, Oregon, and California. NOAA Tech Memo. NMFS-NWFSC-24.

# ESSENTIAL FISH HABITAT ASSESSMENT

The Federal Register (1997) defines Essential Fish Habitat (EFH) as those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity. Waters include aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish. Adverse effect, as defined by NOAA Fisheries, "is any impact which reduces quality and/or quantity of EFH. Adverse effects may include direct or indirect physical, chemical, or biological alterations of the waters or substrate and loss of, or injury to benthic organisms, prey species and their habitat, and other ecosystem components. Adverse effects may be site-specific or habitat-wide effects, including individual, cumulative, or synergistic consequences of actions."

Currently there are no plans for physical or chemical alteration of waters designated as EFH at any of the proposed projects for Caspian tern management in Washington (Dungeness NWR), Oregon (Fern Ridge Lake) or the San Francisco Bay area (Brooks Island, Hayward Regional Shorelines, and Don Edwards National Wildlife Refuge). The Summer and Crump lake locations do not include EFH and therefore are not considered further.

Impacts to EFH species (Table 1) populations and prey resources of EFH species are expected, however, via harvest by Caspian terns, at Dungeness NWR, Washington, Fern Ridge Lake, Oregon, and the three San Francisco Bay, California locations.

## Dungeness National Wildlife Refuge

The proposed action at Dungeness NWR involves potential changes in management and/or control of nest predators on refuge lands. There are no proposed construction activities that would affect essential fish habitat. Fish preyed upon by Caspian terns at Dungeness NWR that also have designated EFH include salmonids, northern anchovy, flatfish and cod. Salmonids, flatfish and cod were not identified to species level in a diet study (Roby et al. 2004; Table 13) of Caspian terns at Dungeness NWR. For purposes of this assessment, salmonids are assumed to include Chinook, pink and coho salmon; flatfish are considered one of the twelve EFH-listed species of sole, sanddab or flounder and cod is equated to Pacific cod.

Salmonids comprised 31.3 percent of identifiable prey items at Dungeness NWR (Roby et al. 2004). While salmonids were not identified to species level in their study, the three EFH-listed salmonids are known to be present and rearing in the waters of the Strait of Juan de Fuca and thus are an available prey resource for Caspian terns originating from the Dungeness NWR colony. For 2004, the Caspian tern population at Dungeness NWR was estimated at 221-293 pairs. Using an estimate derived from diet studies of Caspian terns at East Sand Island, Columbia River, Oregon, an adult Caspian tern on a breeding colony requires approximately 1,000 (range: 837 to 1,084) fish per breeding season. Coupling the dietary requirement of 1,000 fish per adult tern, the percent salmonids in the diet of Dungeness NWR terns and the 2004 population estimates for this colony, an estimated 132,086 to183,418 (117,000 to 199,000) juvenile salmonids were consumed by terns there. The estimated maximum population for the Dungeness NWR colony, given implementation of the preferred alternative in the EIS for Caspian Tern Management to Reduce Predation of Juvenile Salmonids in the Columbia River

Table 1. Listed Species (NOAA Fisheries letter of November 19, 2004) with Designated EFH in the Estuarine EFH Composite in the States of Washington (Puget Sound), Oregon, and California

| **Groundfish Species** | | **Groundfish Species** | |
|---|---|---|---|
| Leopard Shark | *Triakis semifasciata* | Tiger Rockfish | *Sebastes nigrocinctus* |
| Soupfin Shark | *Galeorhinus zyopterus* | Vermillion Rockfish | *Sebastes miniatus* |
| Spiny Dogfish | *Squalus acanthias* | Yellowtail Rockfish | *Sebastes reedi* |
| California Skate | *Raja inornata* | Arrowtooth Flounder | *Atheresthes stomias* |
| Spotted Ratfish | *Hydrolagus colliei* | Butter Sole | *Isopletta isolepis* |
| Lingcod | *Ophiodon elongatus* | Curlfin Sole | *Pleuronichthys decurrens* |
| Cabezon | *Scorpaenichthys* | Dover Sole | *Microstomus pacificus* |
| Kelp Greenling | *Hexagrammos* | Flathead Sole | *Hippoglossoides elassodon* |
| Pacific Cod | *Gadus macrocephalus* | Petrale Sole | *Eopsetta jordani* |
| Pacific Whiting (Hake) | *Merluccius productus* | Sand Sole | *Psettichthys melanostictus* |
| Black Rockfish | Sebastes maliger | Longnose Skate | *Raja rhina* |
| Bocaccio | Sebastes paucispinis | Sablefish | *Anoplopoma fimbria* |
| Brown Rockfish | *Sebastes auriculatus* | Canary Rockfish | *Sebastes pinniger* |
| Copper Rockfish | *Sebastes caurinus* | China Rockfish | *Sebastes nebulosus* |
| Quillback Rockfish | *Sebastes maliger* | Darkblotched Rockfish | *Sebastes crameri* |
| English Sole | *Pleuronectes vetulus* | Greenstriped Rockfish | *Sebastes elongatus* |
| Pacific Sanddab | *Citharichthys sordidus* | Big Skate | *Raja binoculata* |
| Rex Sole | *Glyptocephalus zachirus* | Starry Flounder | *Platichthys stellatus* |
| Rosy Rockfish | *Sebastes rosaceus* | Rock Sole | *Lepidopsetta bilineata* |
| Rougheye Rockfish | *Sebastes aleutianus* | Pacific Ocean Perch | *Sebastes alutus* |
| Sharpchin Rockfish | *Sebastes zacentrus* | Redbanded Rockfish | *Sebastes babcocki* |
| Shortspine Thornyhead | *Sebastolobus alascanus* | Redstripe Rockfish | *Sebastes proriger* |
| Stripetail Rockfish | *Sebastes saxicola* | Rosethorn Rockfish | *Sebastes helvomaculatus* |
| | | | |
| **Coastal Pelagic Species** | | | |
| Pacific Sardine | *Sardinops sagax* | | |
| Pacific (Chub) Mackerel | *Scomber japonicus* | | |
| Northern Anchovy | *Engraulis mordax* | | |
| Jack Mackerel | *Trachurus symmetricus* | | |
| California Market Squid | *Loligo opalescens* | | |
| | | | |
| **Pacific Salmon Species** | | | |
| Chinook Salmon | *Oncorhyncus tshawytcha* | | |
| Pink Salmon | *Oncorhyncus gorbuscha* | | |
| Coho Salmon | Oncorhyncus kisutch | | |

Estuary, is 1,000 pairs. Juvenile salmonid consumption at the 1,000 pair level, assuming that the percent of salmonids in the tern diet remains comparable to 2004, is estimated at 626,626 juvenile salmonids. This would represent a net increase of 443,025 to 494,408 juvenile salmonids harvested by Caspian terns at this colony.

Juvenile salmonids consumed by Caspian terns from the Dungeness NWR colony would include an unknown number each of juvenile Chinook, coho, pink, chum, and sockeye salmon, plus steelhead, and Coastal cutthroat and bull trout. The first three species represent EFH species. Juveniles from all these salmonid species would be expected to rear, forage and/or transit the Strait of Juan de Fuca. Size of these juvenile salmonids would be expected to vary by species and time of year. It is assumed that these juvenile salmonids would attain a size within the length range of fish taken by Caspian terns during the course of the tern breeding season. The proportion of juvenile salmonids harvested by terns would be governed by size and foraging strategies of juvenile salmonids. Juvenile salmonids that are demersal or mid-depth feeders would be unlikely to occur as prey of Caspian terns whereas those juveniles that forage at or within one meter of the water surface would be vulnerable to tern predation. Abundance of salmonid juveniles by species will also represent a factor in their harvest by Caspian terns and would be expected to vary annually. Consequently, it is not possible to estimate the exact take of the three listed EFH salmonid species by Caspian terns at Dungeness NWR although it is expected to occur on an annual basis.

Northern anchovies comprised 0.8 percent of identifiable prey items at Dungeness NWR (Roby et al. 2004). An estimated 3,379 to 4,693 anchovy were taken by Caspian terns in 2004 based upon an estimator derived from Columbia River Caspian tern diet composition studies. Should the tern colony at Dungeness NWR attain the maximum projected size of 1,000 pairs, and percent of northern anchovies in their diet remain constant, then 16,000 northern anchovy are projected to occur in the terns diet at Dungeness NWR. This would represent a net increase of 11,307 to 12,621 northern anchovies or an estimated increase of 530 – 592 pounds consumed by terns. By contrast, landings of northern anchovies in Washington from 1987-1996 varied between 40 and 140-plus tons annually. Increased take by terns is negligible in comparison to the commercial fishery harvest.

Cod, assumed to be Pacific tomcod, and flatfish species, were very minor components of the Caspian tern diet in 2004 at Dungeness NWR, comprising 0.02 percent and 0.2 percent of identifiable prey items (Roby et al. 2004). The estimated net increase in consumption for cod and flatfish is approximately 300 and 3,000 fish annually with a tern population of 1,000 pairs at Dungeness NWR. This is considered a minor take of these EFH fish species.

Juvenile salmonids, northern anchovy, cod and flatfish consumed by Caspian terns from the Dungeness NWR colony represent a prey resource for many, if not all of the groundfish species listed in Table 1. Groundfish species are anticipated to be opportunistic feeders and would be expected to capitalize on these species as a prey resource. Similarly, Pacific and jack mackerel plus California market squid would be anticipated to take these species in the coastal pelagic environment. Chinook and coho salmon would also be expected to forage on their salmonid brethren.

***Conclusion:*** Chinook salmon – may adversely affect
Pink salmon – may adversely affect
Coho salmon – may adversely affect
Flatfish spp. (sole, sanddab, starry flounder) – may adversely affect
Cod (Pacific cod) – may adversely affect
Groundfish spp. – may adversely affect

The take of EFH fish species associated with the Dungeness NWR Caspian tern colony represents a minimal adverse affect to these species. Most of these species are subject to commercial and/or sport fisheries whose consumptive use exceeds that expected for Caspian terns.

## Fern Ridge Lake

As noted in the biological assessment addressing Fern Ridge Lake, the proposed establishment of a tern colony at that location will result in the take of juvenile Upper Willamette River Spring Chinook, a listed ESU. Due to hatchery release practices and strategies, juvenile spring Chinook released from hatcheries will have minimal exposure to Caspian tern predation. However, wild juvenile spring Chinook will have a greater exposure due to their in-river rearing habits in the lower McKenzie and mainstem Willamette Rivers in the vicinity of Fern Ridge Lake. Physical characteristics of these rivers coupled with availability of alternative prey species, initial size of these wild juveniles plus their use of instream habitats are expected to limit their vulnerability to Caspian tern predation. The majority of the tern population is expected to forage at Fern Ridge Lake but a sizable proportion of the terns comprising the Fern Ridge Lake colony could forage in the lower McKenzie and mainstem Willamette Rivers. Another factor that will substantially limit the amount of predation incurred by juvenile spring Chinook in these streams is the small size, e.g., 5-300 pairs, of the Caspian tern colony projected for Fern Ridge Lake. The colony is expected to take many years to build to the maximum projected size which will allow time for prey composition studies to occur. Further, habitat conditions at the island developed for terns at Fern Ridge Lake can be reversed to make the site smaller and/or unsuitable for Caspian tern nesting if their predation on juvenile spring Chinook is determined to be a significant problem.

***Conclusion:*** Chinook salmon – may adversely affect

The presence of a Caspian tern colony is anticipated to result in an adverse impact to juvenile Upper Willamette River Spring Chinook. Due to various factors identified above, plus the capability to limit or eliminate the Caspian tern habitat at Fern Ridge Lake if necessary, this adverse impact is considered minimal.

## San Francisco Bay

Fish preyed upon by Caspian terns in San Francisco Bay (Roby 2004) that also have designated EFH includes Chinook salmon (*Oncorhynchus tshawytscha*), northern anchovy (*Engraulis mordax*) and leopard shark (*Triakis semifasciata*). Twelve species of flatfishes also have designated EFH. Flatfishes were not identified to species level in diet studies of Caspian terns at San Francisco Bay, however. Northern anchovies are an important component of the diet of Chinook salmon at sea but relative importance of prey items of many fish species in areas of upwelling such as northern California can fluctuate significantly from year to year. A study in northern California in 1995 showed that northern anchovies comprised 33 percent of the diet of Chinook salmon (Hunt et al. 1999). Central California coast coho salmon (*Oncorhynchus kisutch*) occur sparsely in San Francisco Bay and have designated EFH. The diet of coho salmon at sea consists largely of herring and sandlance but includes other small fishes, squid, and an assortment of crustaceans (Clemens and Wilby 1961).

Projected net increase in take per nesting season, assuming 3,000 nesting birds at each of the three colonies for a net increase in the tern population of 6,920 birds, is 1,149,869 northern anchovies, 13,854 leopard sharks, and 6,927 flatfish (species combined). Projected increases in take by an additional 460 pairs of Caspian terns at Brooks Island for juvenile Chinook salmon are estimated at 30,400 fish. Take for juvenile coho salmon was not projected because population numbers for this species in the vicinity of San Francisco Bay are unknown and very limited.

For northern anchovies sampled in bill loads of Caspian terns in the Columbia River in 2002, mean fork length was 133 mm and weight was 0.75 oz (sample size = 56 fish) (Realtime Research, Inc. 2002). Assuming size of anchovies taken are similar in the Columbia River and San Francisco Bay, this equates to a projected net increase in take of approximately 54,000 pounds of northern anchovies per nesting season for all colonies at their maximum sizes of 3,000 nesting birds each (assumes a net increase of 460 pairs at Brooks Island from the 2004 Caspian tern colony size of 1,040 pairs).

Landings data (California Dept. Fish and Game Internet Site) show that in 2002, 10,236,838 pounds of northern anchovies were harvested in California of which 37,856 pounds came from the San Francisco Bay area (0.37 percent of the total for California). All of the harvest in the San Francisco Bay area came during the months of April, May, and June. For leopard shark, landings data for 2002 show that 24,831 pounds were harvested in California of which 6,227 pounds came from the San Francisco Bay area (25.1 percent of the total for California). For Chinook salmon, landings data for 2002 show that 4,821,245 pounds were harvested in California of which 1,834,474 pounds came from the San Francisco Bay area (38.0 percent of the total for California) (California Dept. Fish and Game Internet Site).

***Conclusion:*** Northern anchovy – may adversely affect
Chinook salmon – may adversely affect
Coho salmon – may adversely affect
Leopard shark – may adversely affect
Flatfish spp. (sole, sanddab, starry flounder, etc.) – may adversely affect
Groundfish spp. – may adversely affect

Implementation of the proposed projects in San Francisco Bay will result in take of fish species with designated EFH. There is no impact to EFH habitat. The affected species that have been identified in the diet of Caspian terns in San Francisco Bay include northern anchovies, a prey resource for Chinook and coho salmon, plus many of the other EFH listed species, including groundfish species. This adverse effect by Caspian terns represents a small proportion of the anchovies taken by the commercial fishing industry in California and therefore is considered to have a minimal adverse effect on northern anchovy. Harvest of juvenile leopard sharks and flatfish species are expected to have a minimal adverse effect to these species given that Caspian terns only harvest a small number of juveniles. The net increase in juvenile Chinook salmon taken by Caspian terns of approximately 30,400 fish, the majority of which are non-listed fall Chinook, represents a minimal but less than substantial effect. For perspective, a 2 percent return of adults averaging 20 lbs each from the additional take of 30,400 juvenile Chinook by Caspian terns would represent 608 adults and 12,160 lbs of adult salmon or less than one percent of the 2002 Chinook salmon poundage that came from the San Francisco Bay area.

## Literature Cited

Anderson, S.K., D.D. Roby, D.E. Lyons, and K. Collis. *In Review*. Effects of food availability on foraging patterns, diet, and nesting success of Caspian terns in the Columbia River estuary.

California Department of Fish and Game. Internet site. Showing landings data. www.dfg.ca.gov/mrd/landings02.html

Clemens, W.A. and G.V. Wilby. 1961. Fishes of the Pacific Coast of Canada. Fisheries Research Board of Canada. Bulletin No. 68.

Federal Register. 1997 (December 19). 50 CFR Part 600. Magnuson-Stevens Act Provisions; Essential Fish Habitat.

Hunt, S.L., T.J. Mulligan, and K. Komori. 1999. Oceanic feeding habits of Chinook salmon, *Oncorhynchus tshawytscha*, off northern California. Fisheries Bulletin. 97:717-721.

Realtime Research, Inc. 2002. Data.

Roby, D.D. K. Collis, S.K. Nelson, K. Larson, and K. Bixler. 2004 (September). Caspian Tern Nesting Ecology and Diet in San Francisco Bay and Dungeness NWR: Draft 2004 Annual Report.

# Appendix A. Potential Take Estimates

**Table A.1. Estimates for Caspian tern juvenile salmonid predation at East Sand Island**

| Year | No. of Terns | Mean # Juvenile Salmonids Consumed by Terns | # juvenile salmonids consumed per tern | % Juvenile Salmonids in Tern diet | Estimated # of fish consumed annually by one adult tern at ESI colony. | Notes: |
|---|---|---|---|---|---|---|
| 2000* | 17026 | 6,700,000 | 394 | 47 | 837 | Data for East Sand Island colony - Collis et al. 2002. Caspian Tern Research on the Lower Columbia River FINAL 2000 Season Summary |
| 2001* | 17964 | 5,800,000 | 323 | 33 | 978 | Note: From Collis et al. 2002b; page 9; 22% of Chinook were yearling Chinook and 20% were sub-yearlings. |
| 2002* | 19866 | 6,500,000 | 327 | 31 | 1055 | Note: From Collis et al. 2003a |
| 2003* | 16,650 | 4,200,000 | 252 | 24 | 1051 | Note: From Collis et al. 2003b; page 10; 26% of Chinook were yearling Chinook and 17% were sub-yearlings. |
| 2004 | 19,000 | 3,500,000 | 184 | 17 | 1084 | From Roby (2004) AFEP presentation. |
| **Sum - 2000-2004** | **90506** | **26,700,000** | **1480** | **152** | **5006** | |
| **Mean**** | **18,101** | **5,340,000** | **296** | | **1001** | |

**Table A.2 Potential Take Estimate by Projected Increased Number of Caspian Terns (compared to 2004) for proposed actions at Dungeness NWR, Washington**

| Projected Tern Colony Size (No. of Terns) | % Juvenile Salmonids in Tern Diet | Total no. of salmonids consumed |
|---|---|---|
| 2,000 | 31.3 | 443,000 to 494,000 |

**Table A.3 Potential Take Estimate by Projected Number of Caspian Terns for Proposed Actions at Fern Ridge Lake, Oregon.**

| Projected Tern Colony Size (No. of Terns) | % Juvenile Salmonids in Tern Diet | Potential Take of juvenile Chinook |
|---|---|---|
| 300 (50% of the projected 600 birds are expected forage in areas with juvenile Chinook) | 26 | 2,340 to 7,800 |

**Table A.4 Potential Take Estimate by Projected Increased Number of Caspian Terns (compared to 2004) for Proposed Actions at San Francisco Bay, California.**

| Listed ESU | Projected Tern Colony Size (No. of Terns) | % Juvenile Salmonids in Tern Diet | Potential Take of juvenile Chinook |
|---|---|---|---|
| CV steelhead | 920 | 3.3 | 243 – 1,214 |
| CVS Chinook | 920 | 3.3 | 641 |
| SRW Chinook | 920 | 3.3 | 33 |
| CCC steelhead | 920 | 3.3 | 30 – 151 |
| CCC coho | 920 | 3.3 | 30 - 151 |